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Issued February 6, 1909.

U. S. DEPARTMENT OF AGRICULTURE.

Report No. 87.

REPORT

OF THE

SECRETARY OF AGRICULTURE.

1908.

[ABRIDGED EDITION.]

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
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REPORT

OF THE

SECRETARY OF AGRICULTURE.

Mr. PRESIDENT:

I respectfully present my Twelfth Annual Report, covering the work of the Department of Agriculture for the year 1908.

The crops of the year and the other products of the farm first claim attention, after which the work of the Bureaus and other offices of the Department, in and outside of Washington, is summarized. Then follows a review of the progress of agriculture in this country during the last twelve years, with concise statements of the principal causes and the more prominent results.

AGRICULTURAL PRODUCTION IN 1908.

TOTAL VALUE.

Billions upon billions the farmer has again piled his wealth. Production has been above the average of recent years all along the line, with few exceptions, and some prices have been up while others were down. After offsetting losses against gains, in comparison with 1907, there remains a net gain which raises the total value of all farm products of 1908 to the most extraordinary amount in the world's history, $7,778,000,000.

INCREASE ABOVE FORMER YEARS.

The farm value of farm products this year is $290,000,000 above the value for 1907, $1,023,000,000 above that of 1906, $1,469,000,000 above that of 1905, $1,619,000,000 above that of 1904, $1,861,000,000 above that of 1903, and $3,061,000,000 above the census amount of 1899.

Expressed in the form of percentages of increase, the amount for 1908 was 4 per cent greater than that for 1907, 15 per cent over that for 1906, 23 per cent over that for 1905, 26 per cent over that for 1904, 31 per cent over that for 1903, and 65 per cent over that for the census year 1899.

A simple series of index numbers shows the progressive movement of wealth production by the farmer in another form. The value of products in 1899, the census year, being taken at 100, the value for 1903 stands at 125, for 1904 at 131, for 1905 at 134, for 1906 at 143, for 1907 at 159, and for 1908 at 165.

During the last ten years the wealth production on the farms of this country has exceeded the fabulous amount of $60,000,000,000.

CHIEF CROPS.

In the statement that follows concerning the crop quantities and values for 1908 no figures should be accepted as anticipating the final estimates of this Department to be made later. Only approximations can be adopted, such as could be made by any competent person outside of this Department.

CORN.

Greatest of all crops is Indian corn, the priceless gift of the Indian, who freely gave to the white man information which led to the production of 2,643,000,000 bushels this year. The crops of three years have exceeded this, but only the crop of one year—1906—exceeded it very much.

The value of this crop almost surpasses belief. It is $1,615,000,000. This wealth that has grown out of the soil in four months of rain and sunshine, and some drought, too, is enough to cancel the interest-bearing debt of the United States and to pay for the Panama Canal and 50 battle ships.

The price of corn is exceptionally high. There are only two years in the records of this Department in which the farm price of this crop was as high as it is for this year. In 1881 the price was 63.6 cents; in 1901, when there was only two-thirds of an ordinary crop, the price was 60.5 cents.

The total value of this crop is by far the highest ever reached. The crop of 1902 was worth a billion dollars, and the crops of 1904, 1905, and 1906 were worth $100,000,000 more; the great increase of $300,000,000 over the crop of 1902 was made in 1907, and now the increase is $600,000,000, equal to the gold in the treasury of a rich nation.

The corn crop far exceeds in value the prominent farm crops next below. It is worth nearly as much this year as the great crops of cotton, hay, and wheat combined.

In comparison with the averages of the preceding five years, the quantity of the corn crop of this year is 2.1 per cent higher and the value 42.6 per cent higher.

COTTON.

Commercial interests have agreed upon a large cotton crop for 1908–9, and, accepting their opinion for the moment, it seems likely that the crop stands with the highest three years in quantity. In value, however, it is apparently next to the highest, and perhaps equal to that, although the farm price of cotton this year is below the price of last year by more than 1 cent.

The average cotton crop of the preceding five years is considerably exceeded by the crop of this year, yet the value this year is hardly above the five-year average.

For the first time in the history of this country's agriculture the value of the cotton crop, including the seed, has apparently exceeded the value of the hay crop, which has heretofore held second place for a long series of years.

HAY.

The reason the value of the hay crop has lost its relative place in the scale of crop values is that the price is low because of high production. The price this year at the farm is more than $2 per ton less than it was a year ago; so that, although the number of tons harvested this year was 68,000,000, or 11.7 per cent above the average of the preceding five years, the total value is but $621,000,000, or only 5.7 per cent above the five-year average. Otherwise compared, the hay crop is the largest ever produced in this country, and its total value has been exceeded but once.

WHEAT.

Wheat is 1.5 per cent above the five-year average in production and 23.3 per cent above that average in total value. The story would have been somewhat different had this country depended upon spring wheat alone. since that crop suffered considerably because of the drought.

In quantity the wheat crop is 660,000,000 bushels, and has been often exceeded, while the value is $620,000,000, and was never equaled, nor approached nearer than $66,000,000.

OATS.

The fifth crop in value is oats, with a total of $321,000,000, or 9.6 per cent above the five-year average. The quantity, however, was 9.3 per cent below the five-year average, and was represented by 789,000,000 bushels, the low amount being due to protracted drought. In only one year, 1907, has the total value of the oat crop exceeded the value this year, but the quantity has often been exceeded.

BARLEY.

The cereal crop next below oats in value is barley, with a production of 167,000,000 bushels, worth $86,000,000 at the farm. The number of bushels and their value have been exceeded only once, but in a comparison with the averages of the preceding five years the production is higher by 13 per cent and the total value by 22.6 per cent.

RYE.

Rye is a crop that has remained steady at a production of about 30,000,000 bushels or a little more in recent years, and the crop of this year is higher in comparison with the five-year average by only 3 per cent, although the total value is higher by 17 per cent. This value is about $22,000,000, which has been exceeded three times.

RICE.

The large rice crop of this year, 23,000,000 bushels, gives it a value close to that of the rye crop, or about $18,000,000. This is 28.7 per cent above the average of the preceding five years in quantity and 22.7 per cent above it in value.

No year has produced such a rice crop as this one in quantity, nor has the rice crop of any former year been worth as much to the producer.

ALL CEREALS.

When buckwheat is added to the cereals above mentioned, interesting totals are provided. While all of these cereals are measured by the bushel, they are not fully comparable one with another on this basis; but, after all, in the grand aggregate of bushels of cereals there is some indication of comparative production, one year with another. The total quantities of cereals produced in this country this year is 4,329,000,000 bushels, an amount that has been exceeded three times.

The value of all cereals reaches the grand total of $2,694,000,000, an amount that is more than $300,000,000 above that of last year, and still greater than in former years.

In the five-year comparison, the number of bushels of cereals this year is higher by 0.2 per cent, and the value is higher by 32 per cent.

POTATOES.

On account of the unfavorable weather, the potato crop of this year is low in quantity, 275,000,000 bushels, being 5.1 per cent below the five-year average and having often been exceeded by crops of former years. In value, however, $190,000,000, this crop is 18.1 per cent above the five-year average and was never equaled in any other year.

SUGAR BEETS AND CANE.

In the production of sugar beets for sugar making, this year stands at the top, both in quantity and in its value to the farmer, although in both respects not much above the figures for 1906 and 1907; but, in comparison with the average of the preceding five years, the tonnage of this year is higher by 44.7 per cent and the value, $21,500,000, by 43.7 per cent.

The plantation value of sugar cane, molasses, and sirup for 1908 is estimated to be about $34,000,000, a value which was exceeded only in 1904, but in comparison with the five-year average the value is greater this year by 9.7 per cent.

The foregoing figures relate to raw materials of sugar, but it is always interesting to notice the estimates of the values of the finished product, or refined sugar for beets and raw sugar for cane.

The beet-sugar production from the crop of 1908 reaches a higher figure than ever before, or about 500,000 short tons, worth at the factory, with the pulp, about $45,000,000; this value also is higher than for any preceding year.

In the case of the raw sugar of cane, the production of 1908 has a commercial estimate of about 407,000 short tons, a quantity perceptibly greater than the high figures of four or five former years. The value of this product has been exceeded in only one year, 1904.

The value of the sugar beet and of the sugar cane to the grower, with the addition of such molasses and sirup as are made on the farm and outside of factories, makes a total of about $56,000,000 for 1908.

On combining beet sugar with cane sugar, the total production of 1908 is estimated to be about 900,000 short tons, an amount much above the total of the highest former year; the factory value of the two kinds of sugar is supposed to be $75,000,000, and this holds the record place.

The grand total value of the refined sugar of beets, of the raw sugar of cane, of beet pulp, of molasses and sirup of cane and sorghum, and of maple sugar and sirup, resulting mostly from commercial estimates, is $94,000,000 for 1908.

TOBACCO.

Tobacco production has been low for several years on account of a depression in price, but the price rose considerably in 1907 and is perhaps still higher this year. Apparently the value of the tobacco crop to the farmer this year is at least $70,000,000, or about the value of 1907, and much higher than in preceding years.

While the crop is under the five-year average in quantity, its value is over 15 per cent higher.

HOPS.

The extremely low price of hops in 1907 caused a great reduction in the acreage of 1908, with the result that the commercial estimate of the crop is 39,000,000 pounds, the value of which is about $4,000,000, both amounts being exceeded in many former years.

In comparison with the preceding five years, the quantity of the hop crop is lower by 27.6 per cent and the value by 42.9 per cent.

ALL FARM CROPS.

For the first time, the value of all farm crops this year equals $5,000,000,000, and of this total the value of the corn crop is about one-third; wheat, hay, and cotton combined make more than one-third; and the smaller crops the remainder, or nearly one-third.

The crop production for the year is on the whole a high one. Never before was the hay crop so large in quantity, nor the rice crop, nor the sugar-beet crop, nor beet and cane sugar production. The production of barley has been exceeded in only one former year, and cotton has been exceeded by only two years at the most.

With regard to crop values, this year leads all former years in the case of corn, wheat, rice, all cereals, potatoes, sugar beets, beet sugar, beet and cane sugar combined, and possibly tobacco.

Next to the highest value, in comparison with former years, was reached by cotton, hay, barley, oats, sugar cane, and cane sugar.

In comparison with the preceding five years, crop production has been higher for every crop mentioned above except oats, flaxseed, potatoes, tobacco, and hops; values were higher than the average of the preceding five years for every crop except cotton seed and hops.

Notwithstanding two or three rather alarming periods of drought during the growing season, after all, the crop production of the year stands high, although not extraordinarily so, and the level of values is high.

ANIMAL PRODUCTS.

To the farmer who has averaged hardly 20 cents a pound for the butter that he has sold, between 3 and 4 cents a quart for his milk, and about 1½ cents for each egg, and even to the consumer who has paid prices much above these, it is a striking fact that the value of the farm products of the dairy cow are getting closer and closer to $800,000,000, and that the eggs and poultry produced on the farm are worth as much as the cotton crop, seed included, or the hay crop, or the wheat crop.

These advances in value are not due solely to increase in number of cows and of poultry, but considerably also to advances in price. The mean factory price of Elgin butter was 19.66 cents in 1899, 28.5 cents in 1907, and 27.16 cents in 1908. The mean farm price of eggs throughout the United States was 11.15 cents in 1899, 17.02 cents in 1904, and 18.3 cents in 1908. The wholesale milk prices at Chicago and New York, respectively, were 10.5 and 10.12 cents per gallon in 1899, 12.24 and 11.76 cents in 1905, 14.375 and 12.886 cents in 1907, and 15.16 and 16.62 cents in 1908.

The mean wholesale price of dressed poultry in New York was 11.15 cents per pound in 1899, 12.97 cents in 1903, 14.9 cents in 1907, and 13.56 cents in 1908.

The aggregate value of animals sold and slaughtered increases year by year because of increasing number and also because of a rising price level, although in the case of some classes of animals prices fall at times.

In the aggregate the value of animals sold and slaughtered and of animal products at the farm amounts to about three-eighths of the value of all farm products, estimated upon the census basis. This value is getting closer and closer to $3,000,000,000.

FOREIGN TRADE IN AGRICULTURAL PRODUCTS.

EXPORTS.

Never before in the foreign trade of this country have the exports of domestic agricultural products been as valuable as they were in the fiscal year ending June 30, 1907, but the amount was only $37,000,000 below that amount in 1908, when the value of these exports was $1,017,000,000, or greater than for any year except 1907.

The falling off in exports in 1908 was due mostly to cotton, which showed a decrease of $43,000,000, a loss which was partially offset by an increase of $31,000,000 in exports of grain and grain products.

By far the largest item or group of agricultural exports was cotton, with a value of $438,000,000; next, grain and grain products, $215,000,000; and, third, packing-house products, valued at $196,000,000.

IMPORTS.

The loss in imports of agricultural products in 1908, compared with 1907, was $87,000,000, or much more than the loss of exports, the principal item of decrease being packing-house products; on the other hand, there were increases, chief among which were fruits and vegetables.

The principal items of import in 1908 were silk, $65,000,000; wool, $24,000,000; packing-house products, such as hides, etc., $66,000,000; coffee, $68,000,000; various vegetable fibers, $50,000,000; fruits, $28,000,000; vegetable oils, $16,000,000; sugar and molasses, $81,000,000; tea, $16,000,000; and tobacco, $23,000,000.

The total imports of agricultural products in 1908 were valued at $540,000,000 in the countries from which they were exported, a decrease of $87,000,000 from the amount of 1907.

TRADE IN FOREST PRODUCTS.

A decrease of $2,600,000 was the result of the export trade of this country in forest products of domestic production in 1908 as compared with 1907, due mostly to a decrease in value of exports of lumber and, in a less degree, of timber.

There was a diminution also in the value of imports of forest products in 1908 compared with 1907, the loss being $24,000,000, found almost entirely in india rubber. There was a gain of $2,000,000, however, in the value of pulp wood and of $1,000,000 in wood pulp.

COMPARISON OF CLASSES OF EXPORTS.

On account of the sudden expansion of exports of manufactured products during the fiscal year 1908 the fraction of the value representing agricultural products and commodities whose manufacture is sustained mainly by agricultural materials declined somewhat in comparison with recent years and is now 61.5 per cent, while the fraction for forest products and for commodities whose manufacture is mostly sustained by forest products as materials is 7.8, and the fraction for exports that are not agricultural, nor of forest origin, either fully or in principal degree, is 30.7.

Animals and animal products contributed 16 per cent to the value of the total exports of 1908; cotton and cotton products, 26.9 per cent; grain and grain products, 12.2 per cent; all other products chiefly sustained by agriculture, 6.4 per cent.

BALANCE OF TRADE.

The exports of domestic farm products in 1908 being worth $1,017,000,000, the exports of foreign products being over $10,000,000, and the imports of farm products being $540,000,000, a balance of international trade in favor of the farm products of this country results, with the enormous value of $488,000,000.

During the same period the balance of trade in products other than those of the farm was $178,000,000, or an amount that has not been equaled within the memory of man. The agricultural balance was exceptionally high and has been equaled only in 1901 and 1898. The magnificent figures of the farmers' contribution to the exports of this country and to the favorable balance of trade are maintained in spite of this country's immense growth in population and extraordinary immigration of nonagricultural peoples, and also in spite of the diminishing fraction of the population that is engaged in agriculture. No analysis could more strongly indicate the progressive efficiency of the farmer's labor and capital and the telling effects of the agricultural sciences.

FOREIGN TRADE OF MORE THAN HALF A CENTURY.

AGRICULTURAL EXPORTS AND IMPORTS.

A compilation of the foreign trade of the United States in agricultural and forest products has just been completed as far back as the fiscal year 1851, and for the first time the general results are here made public. Annual averages by five-year periods are used for better understanding.

In 1851–1855 the exported agricultural products of domestic origin were valued at $150,000,000, and in the five years just before the civil war at $229,000,000. After that war the amount steadily grew by five-year periods to the great value of $875,000,000 in 1901–1905 and afterwards to $1,054,000,000 in 1907, the highest year of all.

The exports of agricultural products of foreign origin increased from $8,000,000, the annual average for 1851–1855, to $12,000,000 in 1901–1905, an amount that was not equaled in subsequent years.

The value of the imports of agricultural products at the beginning of the period under review was $68,000,000, as the annual average for 1851–1855. The average was progressive to the last period, with the exception of two five-year periods, and for the five years 1901–1905 it averaged $455,000,000. The highest amount ever reached was $627,000,000 in 1907.

Upon striking a balance of trade the evidence of the most remarkable power of the farmers of this country to produce a national surplus is brought out forcibly. For the first period, 1851–1855, the annual average balance in agricultural products in favor of this country was $89,000,000; the civil war diminished this, but the rise afterwards was fairly steady but firm until the period of 1896–1900, when there was a quick increase in the balance to $387,000,000, after which the amount has been always more than $400,000,000, except in 1905, and in 1901 it was $571,000,000, the highest amount in history.

During the entire period until 1898 the farmer provided this country with a balance of trade in his own products which offset a part or all of the unfavorable balance in the international exchange of commodities other than agricultural. After struggling with the load for a quarter of a century, he was able to overcome the adverse balance in commodities other than his own in 1876, when he began to produce a favorable balance of trade in the total of all commodities, steadily, year after year, with the exceptions of 1888, 1889, and 1893.

The per capita values of the exports of agricultural products expressed in annual averages by five years show that they have more than doubled during the half century under review. The per capita value during the period 1851–1855 was $5.84, and this average grew with several irregularities to $10.88 for 1901–1905 and to $12.29 for 1907, the highest amount of record.

On the other hand, the per capita value of the imports of agricultural products increased from $2.67 for 1851–1855 to $6.25 for 1871–1875, an amount that was not equaled by any subsequent five-year average. The average for 1907 was $7.30, which was higher by $1.05 than the great annual average for 1871–1875.

FOREST PRODUCTS.

The value of the exported forest products of domestic origin has steadily increased during the fifty-eight years under review. Beginning with an annual average of $6,000,000 in 1851–1855, these exports steadily increased in value to $28,000,000 in 1891–1895, after which the rise was rapid to $59,000,000 in 1901–1905, and to $93,000,000 in 1907, which was nearly equaled in 1908.

The per capita average of these export values was 24 cents in 1851–1855 and $1.08 in 1907.

Imports also of forest products have enormously increased in value during the fifty-eight years. They were valued at $2,000,000 as the average for 1851–1855, at $72,000,000 for 1901–1905, at $122,000,000 for 1907, by far the highest amount, and the value for 1908, $98,000,000, was next high.

The per capita value of those imports was 8 cents for 1851–1855 and $1.43 for 1907.

Rosin has increased in quantity of exports from the beginning to the end of the fifty-eight-year period, the number of barrels exported annually in 1851–1855 being 525,000, the number in 1901–1905 being 2,530,000, and in 1908, 2,713,000.

The exports of spirits of turpentine increased in a much greater degree than the foregoing, or from 1,000,000 gallons in 1851–1855 to 18,000,000 gallons for the ten years 1896–1905, after which there was a reduction to 16,000,000 gallons, but the greatest exports for any year were nearly 20,000,000 gallons in 1908.

Wood pulp has declined steadily in exports, the average for 1896–1900 being 45,000,000 pounds. It was 35,000,000 pounds in 1901–1905, 29,000,000 pounds in 1906, 25,000,000 pounds in 1907, and 24,000,000 pounds in 1908.

Imports of various items of forest products gain interest in a review for as long a period of time as fifty-eight years. Imported wood pulp averaged 42,000 tons in 1891–1895, and the gain was steady to 213,000 tons in 1907, and to 238,000 tons in 1908.

The pounds of imported india rubber rose from 38,000,000, the average for 1891–1895, to 77,000,000 in 1907, which was not equaled in 1908.

Imported cabinet woods increased steadily from an average of $515,000 in 1851–1855, to $5,000,000 in 1907, and the imports of timber and lumber other than cabinet woods were multiplied six times in value from 1856–1860 to the present time.

The farmer had many reasons for his Thanksgiving in 1908, as he had in recent former years. He has reaped as well as sowed. He has obtained more of the means with which to improve his farm, to increase his capital, to become a more generous consumer of the goods of other producers, and to add to the things that count for a better living and a more pleasant life.

THE DEPARTMENT'S WORK IN 1908.

LEGAL OPERATIONS.

Owing to the Department's duties in the enforcement of the food and drugs act, the new meat-inspection law, and the amended twenty-eight-hour law, together with the increasing scope and complexity of the Department's operations, the Office of the Solicitor has within the last two years assumed greatly increased importance.

ENFORCEMENT OF THE TWENTY-EIGHT-HOUR LAW.

During the year a very large number of cases have been brought, at the instigation of this Department, against various railway companies for violations of the twenty-eight-hour law, which limits the number of hours during which a shipment of live stock may be kept in cars without unloading. In 401 of these cases penalties were imposed amounting in all to $61.530, and costs were assessed amounting to $7,201.70, and 828 cases were pending at the close of the year.

OFFENSES AGAINST QUARANTINE LAWS.

For the failure to properly placard cars containing shipments of southern cattle from below the quarantine line, 33 cases were reported to the Attorney-General, and favorable decisions in 25 of these cases resulted in penalties aggregating $2,400 and costs amounting to $123.83. Fines of $100 and costs were imposed in each of 4 cases against individuals for illegally removing southern cattle out of the quarantine area. For infractions of the law for the suppression of contagious diseases of animals, 8 cases were reported to the Attorney-General, the offense in each case consisting in the illegal shipment of sheep infected with scabies.

ENFORCEMENT OF FOOD AND DRUGS ACT.

At the beginning of the year no case had been brought for violation of the food and drugs act of June 30, 1906, although the machinery for the enforcement of the act had been created. During the year, however, 135 cases were reported to the Attorney-General, 97 of these being for criminal prosecution and 38 for seizure and condemnation. Of the criminal cases, 14 have resulted in convictions, the fines ranging from $5 to $700 with costs. Of the 38 seizure and condemnation cases, 14 resulted in forfeiture and condemnation. So far not a single case has been decided adversely to the Government.

The Solicitor has devoted much time and attention to the work of the Board of Food and Drug Inspection, of which he is a member. The consideration of questions submitted to the board for determination and the preparation of " Food Inspection Decisions " for the instruction and guidance of those who desire to conduct their business in strict conformity with this law have occupied much time and have been of far-reaching importance in securing compliance with the provisions of this act.

OFFICERS AND EMPLOYEES.

On July 1, 1908, as shown by the report of the Appointment Clerk, there were on the rolls of the Department 10,420 persons, 2,488 employed in Washington and 7,932 outside of Washington. The net increase in the Department force during the year was 1,313. The total number of appointments was 17,819. Of these 15,991 were to temporary or emergency positions, chiefly in the grade of laborer, continuing in most cases not more than three months and in many cases not more than one month, the great majority to positions outside of Washington. Resignations numbered 574, deaths 41, removals for misconduct 41, and separations from the unclassified service 31, while 128 persons declined to accept appointments. By far the largest increase, 741, is in the Forest Service. Positions on the statutory roll (those prescribed by the appropriation act) number 1,161, while 9,259 are on the lump-sum roll. More than 2,600 members of the Department may properly be classed as scientists. Contingencies arising in the Department's field work—demonstration farming, meat inspection, food inspection, protection of the National Forests from trespass and from fire, cattle-tick eradication, moth eradication, and insect fighting—account largely for the temporary appointments.

NEW BUILDING OPERATIONS.

The new Department building was completed during the year. While the contract date for the completion of the general construction work was November 29, 1907, the work was not finished until four months after that date. On March 17, 1908, the building was accepted subject to the completion of several minor items of unfinished work, and steps were immediately taken toward its occupancy by the various Bureaus of the Department, which were very inadequately housed in scattered buildings rented by the Department. All of the general construction and mechanical equipment work has been satisfactorily completed, and final payments have been made thereon.

WEATHER BUREAU.

FORECASTS AND WARNINGS.

A few years ago the Department undertook to establish a research station at Mount Weather, Va., for the investigation of the problems of the air. This institution was planned to meet the highest requirements of science, and at the same time had as an object the acquirement of additional knowledge bearing directly on the forecasting of the weather. Heretofore the forecasts made by the Weather Bureau have been based entirely on the conditions of the air as observed at the surface of the earth, but for several years the Mount Weather station has been sending meteorological instruments into the upper levels of the atmosphere to find out what is going on there, and to obtain, if possible, additional information for the use of the weather forecasters at Washington in making their predictions. This object is now being realized, and the securing of data every day at altitudes of from 1 to more than 4 miles marks an important epoch in the work of the Weather Bureau.

Another important departure, made possible by continued study of the science underlying the art of weather forecasting, is the making of long-range weather predictions. These were begun for practice purposes, but not for publication, about one year ago. Their accuracy became so marked that within the past few months these predictions have been given to the public. We do not wish to hold out too alluring a prospect with regard to forecasts of this character, for at times the condition of the atmosphere may be such that long-range predictions can not be made, but we have demonstrated that in the majority of cases we can foretell a week in advance, and with a high degree of accuracy, the general character of the weather that is to come.

This gratifying result has been attained not only by getting observations from the higher levels of the atmosphere, but more especially by the securing of daily telegraphic reports covering the entire northern hemisphere, these being used in the preparation of a meteorological chart of such detail and extent as is attempted by no other weather service in the world. The value of these forecasts to the agricultural and other industries of the Nation can hardly be measured.

All severe storms on the American coasts and lakes and all severe cold waves and frosts in any portion of the United States during the year were successfully forecast.

RIVER AND FLOOD SERVICE.

With each succeeding year the development of agricultural operations and the extension of business interests more or less dependent upon river stages necessitate some broadening of the field of activity of the River and Flood Service, and during the present year new work has been undertaken as follows:

(1) The establishment of a continuous flood-warning service, operating day and night in times of flood, in that portion of the State of West Virginia bordering on the Ohio River.

(2) The establishment of a new river district center at Binghamton, N. Y., with territory comprising that portion of the watershed of the Susquehanna River at and above Binghamton. This territory was formerly a portion of the Harrisburg, Pa., district.

(3) The opening of new river stations in the watershed of the upper Cumberland River, in the interest of navigation and the lumber industries.

(4) The opening of several new stations at scattered places throughout the country, in order to secure increased efficiency in the flood-warning service.

METEOROLOGICAL RECORDS.

A new series of climatological papers is being prepared, in which the records of precipitation, temperature, dates of the first and last killing frosts, and prevailing wind directions are collected, the precipitation tables including all available data since the year 1871. These reviews are made comprehensive for small sections of the United States, which it is intended gradually to cover in this manner. The papers will be of value to agriculturists, engineers requiring data on water resources, and other citizens who seek information regarding the climate of the several sections.

WATER RESOURCES.

A demand for a better knowledge of the water resources of the United States has become so urgent as to make it advisable to put forth special efforts to supply the necessary data to the public. In the arid and semiarid regions of the West these consist primarily in securing the amount of precipitation from rain and snow in the high levels of the mountains, from which are derived the waters that are used in the storage basins and the irrigation projects now undergoing rapid development. It is a difficult problem to secure regular and accurate observations of the amount of snowfall in the remote regions of the mountains, where there are very few inhabitants, but a special effort will be made by the Weather Bureau to extend the range of observations into the high levels of the mountains.

EVAPORATION STUDY.

In addition to measuring the water resources of the mountains, it is necessary to determine the amount of evaporation in the lower levels, where the storage basins are located. The amount of evaporation in the driest portions of the country, as in the Colorado Desert, may be as much as 8 feet of water annually, although it differs greatly according to circumstances. The importance of securing much more reliable information on this subject has made it desirable to renew the attack upon the problem. The formation of the Salton Sea in the Colorado Desert, by the overflow of the Colorado River during the year 1906, affords a favorable laboratory on a large scale at which to make the proposed research on evaporation. A preliminary study on this subject was conducted by Professor Bigelow in the summer of 1907 at Reno, Nev., for the purpose of securing sufficiently adequate knowledge of the phenomenon to permit a proper planning of the campaign at the Salton Sea. The necessary plant was installed at the Salton Sea during the summer of 1908, and it is hoped that by continuing the observations for two or three years a satisfactory law covering evaporation generally may be secured. The problem is one of unusual difficulty from several points of view, but its practical value is such as to justify a serious effort to resolve it. The plan of cooperation with other Departments of the Government has been enlarged to include the Reclamation Service and the water resources branch of the Geological Survey, which are specially interested in evaporation at the reservoirs not only of the arid portions of the West, but in the eastern districts of the country. During the summer of 1908 several plants for the measurement of evaporation were installed at the reservoirs of the Reclamation Service and if practicable some other reservoirs in the central and eastern districts will be included. It is important to measure the evaporation in different climates on a uniform plan in order that a comprehensive law may be deduced.

BUREAU OF ANIMAL INDUSTRY.

ANOTHER OUTBREAK OF FOOT-AND-MOUTH DISEASE.

For the first time in six years the country has been visited with an outbreak of contagious foot-and-mouth disease, and the Department is now engaged in a vigorous campaign of eradication. The first news of the disease was received by telegraph November 10 from Dr. Leonard Pearson, State veterinarian of Pennsylvania, who reported that it existed in the vicinity of Danville and Watsontown, Pa. On the same day Dr. A. D. Melvin, Chief of the Bureau of Animal Industry, accompanied by Dr. John R. Mohler, chief of the Pathological Division, and Dr. R. P. Steddom, chief of the Inspection Division of that Bureau, left for Danville, and they soon confirmed Doctor Pearson's diagnosis.

A quarantine was immediately declared under date of November 12, effective November 13, against the interstate movement of cattle, sheep, swine, and goats from the counties of Columbia, Montour, Northumberland, and Union, and measures were at once taken in cooperation with the State authorities for stamping out the disease by slaughtering and burying the affected and exposed animals and disinfecting the premises which they had occupied. An arrangement was made by which two-thirds of the appraised value of the animals was to be paid by this Department and one-third by the State of Pennsylvania, other expenses to be shared on the same basis.

Within a few days the disease was also found in several other counties in Pennsylvania and in the vicinity of Akron, N. Y., and on November 19 the quarantine was extended to include the entire territory of the States of New York and Pennsylvania. This quarantine prohibited the interstate or foreign movement of cattle, sheep, and other ruminants and swine from either of the States named. Shipments were permitted by rail through those States provided the cars were sealed by the Bureau of Animal Industry before they entered the quarantined territory. Such shipments were allowed to be unloaded in transit only in pens designated by the Chief of the Bureau and which had been cleaned and disinfected. The shipment of dressed carcasses from the States named was permitted only when the hides and hoofs had been removed, and the shipment of hides, skins, hoofs, hay, straw, etc., was forbidden unless such material had been disinfected by the Bureau.

It was fortunate that the Bureau of Animal Industry had available as part of its regular force a large number of trained veterinarians, many of whom had had experience in the successful campaign against foot-and-mouth disease in New England in 1902–3. A sufficient number of these men were quickly ordered to the infected districts and the work of eradication was actively prosecuted. Not only was the work of slaughtering, burying, and disinfecting carried on, but experts were sent to investigate all rumors indicating the presence of the disease in various localities.

It appeared that the cattle causing the Pennsylvania outbreak came through the Buffalo stockyards, and from Buffalo suspicion pointed to Michigan. Inspectors were dispatched to the latter State, and on November 23 I went to Buffalo in company with the Chief of the Bureau of Animal Industry to give personal attention to the situation. Evidences of infection from Michigan became so strong that I immediately proceeded from Buffalo to Detroit. On arrival in the latter city on the night of November 24, positive reports were received from our inspectors that the disease existed in several herds in Wayne County, and I at once declared a quarantine on the State of Michigan, to take effect at 6 o'clock the following morning.

On November 27, the disease having been found in Carroll County, Md., just over the Pennsylvania border, a quarantine was placed on the State of Maryland. The operations in Michigan and Maryland are being conducted on the same cooperative basis with the State authorities as in the other States.

It now seems clear that the present outbreak had its origin near Detroit and that the infection in the other States came from that source.

While it will not be surprising if a few additional diseased herds are found in the localities where the contagion is known to exist, it is hoped that all centers of infection have at last been located and that there will be no further extension of the infected territory. After all known affected herds have been slaughtered and buried and the premises disinfected, it will be necessary to make a careful and thorough inspection from farm to farm in the infected region in order to detect any contagion that may possibly remain. With the combined efforts of the State and Federal authorities there is every reason to believe that the disease will be eradicated within a reasonable time.

The expense of this work will be heavy, and I shall have to ask Congress to make an appropriation sufficient to cover it. For the present the expenses are being paid from the regular appropriation for general expenses of the Bureau of Animal Industry, but this appropriation is not large enough to stand the drain which is being made upon it without seriously affecting the regular work of the Bureau during the remaining portion of the fiscal year.

The Secretary of Agriculture already has power under existing legislation to enforce measures to prevent the introduction of contagious diseases from abroad so far as they are likely to be brought in with imported animals or with hay, straw, forage, or similar material, or meats, hides, or other animal products, from infected countries. No authority is given, however, to prevent the introduction of destructive animal diseases by the importation of virus or cultures of organisms causing such diseases, and I recommend that Congress enact a law which will empower the Secretary of Agriculture to guard against this danger. Such a law should prohibit the importation, except with the permission of the Secretary of Agriculture, of any virus that may be infectious for domestic animals. With this authority the Department could supervise such importations in such a way as to prevent the introduction of contagion by careless and irresponsible persons, while not interfering with any proper scientific work by responsible persons.

THE MEAT INSPECTION.

This was the second year of operation under the new meat-inspection law, and the experience gained has been productive of improvement in the methods of carrying on the work, while the regulations issued have been based on the best scientific knowledge and judgment available. There were engaged in this branch of the service at the close of the fiscal year 2,203 persons, of whom 616 were veterinary graduates. This force exercised a strict supervision over the slaughtering and packing operations at 787 establishments in 211 cities and towns. Compared with the previous year this is a gain of 79 establishments and 25 cities and towns.

As an example of the rigor of the inspection it may be stated that inspection was withdrawn from 8 establishments during the year because of violations of the regulations.

During the past year 53,996,511 animals were inspected before slaughter. Of this number 34,980,571 were hogs, 9,778,189 were sheep, 7,198,224 were cattle, 1,993,461 were calves, and 46,066 were goats. The animals inspected at slaughter numbered 53,973,337, an increase of 6 per cent over the previous year. Of these, 175,126 carcasses and 704,666 parts were condemned, 108,519 carcasses were passed for lard and tallow, and 53,689,692 passed for food. Tuberculosis was the cause of condemnation of about three-fourths of the cattle carcasses and about two-thirds of the hog carcasses that were condemned, and the majority of the other condemned hogs were affected with hog cholera and swine plague.

During the year the Government inspectors passed on nearly six billion pounds of meat-food products processed under their supervision.

There were condemned on reinspection during the year 43,344,206 pounds of meat products which had become sour, tainted, putrid, unclean, or, in the case of fats, rancid, since inspection at slaughter.

There was an increase of 13.8 per cent in the quantity of meats and products certified for export as compared with the previous year. Certificates to the number of 122,295 were issued, covering 1,545,761,808 pounds.

The Federal law has no power over products prepared and consumed within the limits of a State, and a large amount of the meat supply—almost one-half the entire slaughter of the country—comes within this class. The Department has found that the worst sanitary conditions exist at many abattoirs where such meats are produced. It is only natural that suspicious and diseased live stock, such as would fail to pass the Government inspection, find their way into these small establishments, to be thereafter sold and consumed within the State. The Department has, moreover, frequently found preservatives in meats prepared by local butchers. It is therefore very important that State and city health authorities should provide adequate protection to their people by inaugurating a system of abattoir inspection that will do away with the evils mentioned.

INSPECTION OF EXPORT ANIMALS.

The routine work of the Bureau of Animal Industry includes the inspection of animals for export and of the vessels carrying them. During the year 638 inspections were made of vessels in order to see that the fittings, equipment, ventilation, feed, water, attendants, etc., complied with the regulations.

Our very large trade in live cattle with Great Britain is well known. This, together with other foreign consignments, made a total of 448,163 animals inspected for export, and as some were inspected more than once there were 757,890 inspections made. Of the animals sent to Great Britain 381,684 were again inspected on arrival at British ports by Bureau inspectors stationed there, and the losses in transit were less than one-fourth of 1 per cent.

CONTROL OF CONTAGIOUS DISEASES OF ANIMALS.

Gratifying progress has been made in eradicating the southern cattle tick, which spreads the infection of Texas fever and constitutes a heavy burden to the section involved. Since the beginning of this work less than three years ago nearly 64,000 square miles of territory have been freed from this troublesome and costly pest. The work is being done in cooperation with the authorities of the States concerned. There is no question as to the ultimate success of this great undertaking provided the assistance of the States and of the cattle owners themselves is forthcoming. As a result of this work 40,798 square miles were released from quarantine during the fiscal year. This territory was located in California, North Carolina, Tennessee, Virginia, Arkansas, Oklahoma, and Texas. Besides these States active work was carried on in Alabama, Georgia, Louisiana, Mississippi, Missouri, and South Carolina. In connection with this work 2,271,436 cattle were inspected during the year.

Very effective work has been done toward eradicating the diseases known as " scabies of sheep and cattle." During the year there have been released from quarantine on account of sheep scab the States of Idaho and Wyoming, and since the close of the fiscal year an order has been issued releasing Kansas and Nebraska and portions of North Dakota and South Dakota. There were released from the quarantine for scabies in cattle 4 counties in Kansas, 57 counties in Nebraska, and portions of North Dakota and Colorado. The number of inspections of sheep was 59,471,141, and the dippings 17,589,578. Of cattle there were 16,920,100 inspections and 1,527,280 dippings.

The question of tuberculosis in animals, especially in dairy cattle, whereby human beings are liable to be infected through the products, has for some time been an acute one. Statistics show that the disease is on the increase, and it is therefore imperative that efforts be made to cope with this great evil. A conservative estimate was recently made by the Chief of the Bureau of Animal Industry, based on the meat inspection and the records of the tuberculin test, which shows the percentages of our animals affected as follows: Beef cattle, 1 per cent; hogs, 2 per cent; dairy cattle, 10 per cent. The financial loss to our stockmen and dairymen was estimated to be fully $14,000,000 per annum.

In order to discover the disease, the tuberculin test should be systematically applied. The safest way of disposing of affected animals is to kill them, but in order to reduce the financial loss they should be slaughtered at abattoirs having Federal or other competent veterinary inspection. By this means many of the slightly affected carcasses could be safely utilized for food and thus made to yield their meat value.

Perhaps the greatest obstacle to the eradication of tuberculosis from our herds is the expense of the work and the payment of compensation to owners for the slaughter of their diseased animals. In such work that is largely for the public good it seems only just that the Government and the States should provide indemnity for at least a part of the loss. The benefits of eradication would unquestionably justify the expense, and when our herds have once been freed from tuberculosis it should be comparatively easy to keep them in that condition.

At last the problem of discovering a successful method of preventing hog cholera seems to have been solved by the Bureau of Animal Industry. The vaccine or serum prepared according to the methods of Dr. M. Dorset, chief of the Biochemic Division of that Bureau, has been further tested in a practical way during the year, not only by the Department, but by some of the State experiment stations, and its efficiency as a preventive measure has been amply demonstrated. The Bureau has carried on field tests during the year on 50 different farms and has treated approximately 2,000 hogs, with the following results: In herds which had not been exposed prior to treatment. but in which hog cholera appeared subsequent to treatment, all of the vaccinated hogs remained well, while more than 64 per cent of the unvaccinated hogs, which were otherwise kept under the same conditions as "checks," died. In the herds which had been exposed before treatment but which were apparently well when vaccinated, only 4½ per cent of the treated hogs died, while approximately 90 per cent of the checks were lost. In the herds where the disease existed at the time of treatment only 13 per cent of the treated animals were lost, while 74 per cent of the checks died.

In a series of careful tests carried on by Dr. J. W. Connaway at the Missouri experiment station with serum prepared by the Department method the efficacy of the treatment was confirmed, and in a report of this work he said: "The results of these tests are so satisfactory as to leave in every mind no doubt as to the great practical value of this method of preventing hog cholera."

Thirty-seven herds were treated in Michigan under the direction of the State experiment station, and in nearly every case the disease had developed before treatment was begun. Out of 1,819 hogs treated, only 226 were lost.

The director of the North Dakota experiment station reports that when the disease recently appeared in the station herd the Department method of treatment was promptly applied, with the result that not a single animal died. As a further test the vaccinated animals were subsequently exposed to diseased hogs, but none contracted the disease.

The success which has attended the use of this treatment has been such as to warrant the use of the vaccine as an agent for combating the disease throughout the country. To prepare the vaccine on such a large scale, however, is beyond the power of this Department, and steps have been taken to interest the various States in the preparation of the serum. In accordance with this plan conferences of State veterinarians have been held at the Bureau experimental farm at Ames, Iowa, where opportunities have been given them to observe and learn the methods of producing and applying the serum. Already a number of State experiment stations are preparing and distributing the vaccine, some of them making a charge to cover the cost, and it is expected that other States will soon make the necessary provision for such work.

The presence of rabies, or hydrophobia, in dogs is still a menace to our people, and its disseminator, the rabid dog, is all too often allowed to roam at large and unmuzzled. The situation in the neighborhood of the National capital last spring became so alarming that the Commissioners of the District of Columbia were prevailed upon to issue a dog-muzzling order. While the prevalence of the disease has been diminished to some extent, the muzzling order has not been well enforced, and cases of rabies continue to occur.

The pathological laboratory of the Bureau of Animal Industry has continued to examine all animals sent there suspected of having rabies. During the fiscal year 117 such animals were examined and 82 of them were found to have been affected with the disease. The great majority of these came from Washington, D. C.

BLACKLEG VACCINE, TUBERCULIN, AND MALLEIN.

The Bureau has continued the preparation and distribution of vaccine to prevent blackleg in cattle. About 1,200,000 doses were distributed to stock raisers during the fiscal year, and reports indicate that the vaccine continues to be highly effective.

Tuberculin, for the diagnosis of tuberculosis, and mallein, for the diagnosis of glanders, are supplied to official veterinarians and health officers. During the year 213,015 doses of tuberculin and 52,556 doses of mallein were prepared and sent out.

LIVE STOCK IN PORTO RICO.

An investigation of the diseases and conditions of live stock in Porto Rico was undertaken during the past year. The majority of the island cattle carry an admixture of zebu blood as the result of the introduction of a number of zebu bulls in 1858. They are noted for superior size and working ability. Cattle all over the island are infested with ticks. The principal diseases are blackleg among cattle and glanders and epizootic lymphangitis among horses and ponies. There is no mange and no tuberculosis.

ANIMAL HUSBANDRY WORK.

The work in breeding American carriage horses, carried on in cooperation with the Colorado experiment station, continues with good results, and some very promising animals have been produced. During the fiscal year 4 Kentucky mares were added to the stud, which at the close of the year comprised 63 animals.

A stallion, two mares, and a filly were bought for the Vermont work in breeding Morgan horses, and the farm at Middlebury donated by Mr. Joseph Battell has been improved. Horses used in this work were exhibited at two fairs in Vermont and attracted very favorable attention. The Morgan stud consisted of 25 animals at the close of the fiscal year.

An experiment is also in progress in Iowa, in cooperation with the Iowa experiment station, to evolve a breed of American draft horses. The animals in this stud at present are imported Clydesdales and Shires. The horses have done well since their arrival in the summer of 1907, but no foals were obtained during the fiscal year.

The cooperative poultry work at the Maine Agricultural Experiment Station, begun in 1904, has been continued and some of the results are being prepared for publication. Other experiments in feeding poultry by different methods are in progress at the Bureau experiment station, but have not progressed far enough to yield definite results.

WORK RELATING TO THE DAIRY INDUSTRY.

The educational work for the development of dairying in the South has been continued with excellent practical results. Some of the drawbacks to the southern dairy industry are the lack of a sufficient number of good cows, the lack of home-grown feed, and the lack of suitable buildings. Efforts are being made to assist the southern farmers along all these lines. In order to determine which cows are profitable and which unprofitable, the farmers are encouraged to keep records of their herds. As an example of what is being accomplished in this respect, it may be stated that twelve months' records of 719 cows in small herds located in various parts of the South show an average profit per cow of $32.61; the best cow showed a profit of $94.40, and the poorest cow a loss of $3.73. The average profit of the best 10 cows was $79.24, while the poorest 10 cows made an average loss of 1 cent. It often happens that what are regarded as the best cows show, when tested, much poorer results than others in the herd, and it is by keeping records and compiling such information as the foregoing that the farmer is enabled to eliminate the poorer animals and to bring up the average production of his herd to a profitable point.

The Bureau has also assisted the southern farmers by furnishing plans for and supervising the erection of 45 silos, 28 barns, and 5 dairy houses during the fiscal year, and a larger number of such buildings are projected for the coming year.

It is the purpose of the Department to carry on this educational work in the South in cooperation with the State authorities and institutions so far as possible, and to prevail upon the States to take up and continue the work so that the Department may, after getting it well started and showing its benefits, withdraw and devote its attention to other fields. Several of the States have provided men and appropriations for such work, and as the good results become more apparent the interest is increased.

Considerable work has been done during the year for the improvement of milk supplies. This has usually been done by giving assistance to city boards of health and to dairy farmers. One hundred and forty cities have been given more or less assistance during the year and a number of these have made marked improvement in their milk supplies. The score card has proved to be an important agency in improving the sanitary condition of the dairies. By means of this card the specific features are rated on a definite scale, and it is much easier for the health authorities and the dairymen to determine just what conditions need improvement. Two hundred and six dairies with 8,527 cows were inspected and scored during the year, the average score being 51.05 on a scale of 100. Reports have been received on about 10,000 dairies that were rated by officials and persons outside of the Department, and the average score of these was 52.05. It appears that there is a greater need for improvement in methods than for better equipment.

The Bureau has also continued its work of inspecting butter as received at 3 of the principal markets and reporting its condition to the creamery, the purchaser, and the dairy and food department of the State where the creamery is located. By this means many of the creameries have been enabled to improve materially the quality of their product. It has been found, however, that much of the poor quality of butter is due to the fact that some of the cream is very old when received by the creamery and it is impossible to make good butter from such material. This condition is due partly to the competition between the local and the "centralizer" creameries and partly to the way the cream is handled on the farm.

In the enforcement of the law regarding the inspection of renovated butter the Bureau has exercised supervision over 46 factories and has inspected their product and the material entering into it. There was produced during the fiscal year 50,658,158 pounds of renovated butter, a decrease of 12,261,840 pounds.

BUREAU OF PLANT INDUSTRY.

During the past year the work of the Bureau of Plant Industry has been pushed forward vigorously. Its research work in the laboratory has resulted in a number of important discoveries, its experimental field work has developed new methods of applying fundamental principles for the benefit of agriculture, and its efforts in the line of practical demonstrations and cooperation with farmers, fruit growers, and others have brought the Department into close contact with the people.

SEEKING NEW CROPS FOR THE AMERICAN FARMER.

Explorations in China, Korea, and Siberia.—In pursuance of a general policy, energetic efforts have been put forward by the Bureau the past year in the matter of securing new crops and establishing new agricultural industries. During the year more than 2,000 carefully selected, newly introduced plants have been brought in and placed in the hands of thousands of private experimenters and official plant breeders, and others attached to State and other experiment stations of the country. We are still sending abroad many millions of dollars for products which may well be grown at home, and in carrying out the general plan of securing data bearing upon the production of these crops and the crops themselves, the explorations and other work outlined below were carried on. One of the agricultural explorers, Mr. Frank N. Meyer, who for the past three years has been in China and Siberia, returned to this country in July after a continuous search during that time for new crops. This is one of the most extensive pieces of agricultural exploration work which the Department has undertaken. In addition to the many hundreds of new plants which Mr. Meyer secured he has brought back a fund of information which will be valuable in connection with our various lines of work here. Mr. Meyer devoted considerable attention to the Chinese methods of growing crops under dry-land conditions, and the information he secured regarding dry-land farming practices, horticultural methods, market-gardening operations, and the vast forestry practices of the Chinese Empire reveals in a remarkable way the wonderful variety of plants grown by the Chinese and the great similarity of the climate of eastern Asia to that of the United States.

The explorations made by Mr. Meyer in certain of the Chinese provinces reveal the presence of an extensive orchard industry which is worthy of serious consideration for our dry southwestern regions, the Chinese regions and our southwestern country being very similar in climate and soil. Mr. Meyer found extensive orchards of what is known as the "Chinese date," a drought-resistant fruit tree of which the Chinese have developed hundreds of varieties and of which the dried fruits form a most palatable and valuable fruit product with which this country is entirely unfamiliar. He secured numerous varieties of this date, among which was a seedless sort which is now being propagated for distribution in the Southwest.

A large collection of wild and cultivated pears was secured; also varieties of wild walnuts and chestnuts. There were also secured wood for the propagation of the famous Feitcheng peach, specimens of which weigh over a pound, as well as new apricots and wild apples which it is believed will be of particular value to the breeders of the Mississippi Valley, who are developing hardy forms of these plants.

EXPLORATIONS IN CENTRAL ASIA.—Recognizing that the Great Plains region of this country is in much need of assistance, explorations were inaugurated the past year with a view to securing forage and other crops for this vast section of the country. Early in the summer Prof. N. E. Hansen, of the South Dakota experiment station, was sent out to make a thorough exploration and investigate the probable value for the United States of certain promising alfalfas, clovers, grasses, and other crops of southern, central, and western Siberia. In a letter dated October 24, from Omsk, Professor Hansen reported the finding of good seed of one of the three yellow-flowered Siberian alfalfas which he started out to secure. This is the same plant found by Professor Hansen in 1906, and he now states that it is a fine, erect-growing type, with large leaves and large, flat pods. Both the Mongolian and flat-pod alfalfas are now coming to America for the first time, and Professor Hansen deems them very promising, owing to their extreme hardiness and their strong, erect habit, which will make mowing easy.

Professor Hansen also reports the finding of the Siberian lupine clover, which extends to 70° north latitude, which is also a fine, erect plant well liked by stock; also two wild red clovers.

This work of Professor Hansen is carried on in a climate very similar to that of the northern Great Plains region, and it is hoped that the new introductions will add materially to the wealth of the northwestern farms and pastures.

Explorations in Sweden, Denmark, and Germany.—In order to ascertain why American barleys are considered by experts inferior to the best European-grown barley, Dr. Albert Mann, an expert of the Bureau, was sent as an explorer to Sweden, Denmark, England, Germany, and Austria to make a thorough study of the methods employed by our European neighbors in the improvement of one of their most important grain crops. Doctor Mann has secured data regarding the latest processes used by European workers in the breeding and selection of barley for special purposes, and in particular the Svalöf system of collecting and classifying new varieties of this and other grains, and he has been successful in perfecting methods for rapidly determining the value of barleys, methods which will be very useful in the continuation of the important work on the improvement of this crop now under way.

Matting plants for floor mattings.—As the result of previous explorations in the Orient and elsewhere, and as announced in previous reports, the Department has put itself in possession of a collection of matting plants of the best varieties, and the present season has seen the production of matting straw which has been pronounced by experts equal in quality to that grown in the Orient. The first piece of home-woven straw matting has been produced here from straw grown by the American farmer, and the experts are now at work devising cheaper methods of planting, harvesting, splitting, and curing these matting plants, large quantities of which we import every year.

Egyptian cotton in the Southwest.—The United States imports about $15,000,000 worth of Egyptian cotton annually for the manufacture of special fabrics. The growing, grading, and handling of this crop have been so perfected that the product is exceedingly uniform, and the fiber being of a very high quality, fancy prices are always received for it. For a number of years the Department has been endeavoring to establish this crop in the United States. Several years ago some work was undertaken in the Southwest, notably at Yuma, in cooperation with the Reclamation Service on one of their projects. This work has already progressed sufficiently to warrant us in saying that there is a great promise of establishing an important cotton industry in the region mentioned.

The past year a total of about 40 acres was planted to Egyptian cotton at various localities in southern Arizona, seed of the acclimatized strain that has been grown for six years in the Southwest being used. The indications point to an average yield of 1 to 1½ bales per acre wherever the planting was done in good season and the cotton received reasonable care. A good commercial fiber was obtained, satisfactory in strength and fineness but not in the matter of length and color. It is planned to sell the product at the highest price obtainable in order to ascertain approximately what profit can reasonably be expected by growers of Egyptian cotton in the Southwest.

The marked interest in these experiments evinced by a number of American manufacturers of Egyptian cotton makes it reasonable to expect that the Arizona-grown fiber can be marketed advantageously.

THE GROWING OF DUTCH BULBS IN AMERICA.—The United States imports bulbs each year to the value of $300,000 to $400,000. A number of efforts to grow these bulbs in the United States have been made. Certain sections of the State of Washington seem to be well fitted for this sort of work. It is planned to grow bulbs now used by the Department and bought abroad, and by this means aid in demonstrating the feasibility of growing the crop in sufficient quantity for commercial purposes.

EXTENSION OF THE CEREAL WORK.

DURUM WHEAT.—The total production of durum wheat for 1907 appears to have been somewhere between 45,000,000 and 50,000,000 bushels, a little larger than that of the previous year. Of the total crop, over 25,000,000 bushels were exported. For 1908 the crop of durum wheat will probably be something over 50,000,000 bushels. There is already a large export of the 1908 crop, a considerable quantity having been shipped to Russia, from which country our own seed was originally obtained. It is evident that the demand will again exceed the supply before the winter is over.

In connection with durum wheat, the operations of the year have witnessed some new enterprises with respect to utilization of the crop. One of the largest milling firms in the country has used one mill entirely for grinding durum flour, while a very large milling concern in another city has launched into an extensive production of durum wheat semolina for macaroni manufacture. Extensive tests have also been made during the year by prominent bakers in this country and Europe in the use of durum wheat flour for bread, all of which have been fairly successful. Scotch bakers are now importing the wheat for bread making.

EXTENSION OF THE WINTER-GRAIN AREA.—With a view of extending the area of winter-grain production in the Northern and Western States the Kharkof strain of the Crimean or Turkey hard winter wheat group has been still more widely grown during the past year, not only in Kansas and Nebraska but in Colorado, Wyoming, South Dakota, Iowa, and portions of North Dakota, Minnesota, and Wisconsin. In all trials of the various winter wheats on State experimental farms in Wisconsin the Kharkof did much better than other varieties, which included two or three other hardy strains from Russia. An important conclusion derived from several years' experiments with this wheat is that it is particularly hardy in cold districts which are also dry—that is, it is rather remarkable in its resistance to a combination of drought and cold.

CEREALS FOR DRY FARMING.—More attention than formerly is being given to the development of drought-resistant cereals. During the year work has been started at six different stations located in representative sections of the Great Plains and intermountain areas. Large numbers of varieties of grain are being tested at these stations for their hardiness and drought resistance. While only one year's results have been secured, many new varieties introduced have outyielded ordinary sorts from 20 to 50 per cent.

Extension of the rice work.—Important work has been carried on during the year in cooperation with the Louisiana experiment station at Crowley, La. A study has been made on this farm of the manner and time of opening of the rice flower, which will be of much value in aiding all future work in the cross-breeding of rice. A classification of the known varieties of rice has also been prepared, which will be of use in future investigations. Efforts are being made to extend the rice work through the adoption of better varieties, improved methods of growing crops, and the extension of the area into other regions, notably California and Arkansas.

PROGRESS OF FORAGE-CROP WORK.

During the year the important work of encouraging the production of forage crops throughout the country has been vigorously prosecuted. This work has for its primary object the encouragement of the production of forage crops of various kinds wherever it is possible to do so in connection with other systems of farming. A special effort has been put forward to push the production of leguminous forage crops in the South, to extend the field for alfalfa culture in the Middle West and East, and to secure and establish forage crops of various kinds, particularly legumes, for the colder Northwest and the dry sections of the Middle West and Southwest.

Alfalfa extension.—During the past three years an extensive series of cooperative experiments in growing alfalfa has been conducted with farmers in the States of Maryland, Delaware, Virginia, and North Carolina with a view to determining the possibilities of this crop. These cooperative experiments number over four hundred and have been undertaken in many instances with the help of State experiment stations. They have been made primarily to determine the governing factors in the growing of this important crop in the various sections. Some of these factors are now well established, and it is believed that the work done will be of great value in getting this important crop more extensively used throughout the region in question.

Winter legumes for the cotton belt.—Much attention has been given during the past year toward encouraging the greater use of winter legumes. Experiments throughout the South have indicated satisfactory results. Numerous demonstration experiments have been undertaken with farmers in most of the Southern States. In the very numerous instances where failure with these legumes has heretofore been reported the difficulty is found to be due largely to lack of inoculation. Whatever be the factors involved the fact is clear that inoculation is very difficult to obtain in the South except when using soil from an old field of the particular legume planted. The results of the work thus far indicate that crimson clover is to be preferred on the sandy lands, while vetch does best on the heavier soils. Experiments further indicate that when once the land is thoroughly inoculated there is little difficulty in securing satisfactory stands both of vetch and crimson clover when sown in the cotton in late summer.

A new legume for the South.—In 1906 there was obtained from the Philippine Islands a new bean, *Mucuna lyoni*, related to the Florida velvet bean. Although this has been grown but two years, in comparison with the Florida velvet bean it is already demonstrated that it is much more prolific and somewhat earlier, at the same time being just as vigorous a grower. So markedly has its superiority shown itself as regards heavy seed production that many cooperators have not hesitated to predict that it will within a short time entirely supplant the Florida velvet bean. It is not unlikely that this variety will succeed farther north than does the Florida velvet bean, and it is certain that it will ripen its seed considerably farther north than that variety.

TOBACCO INVESTIGATIONS AND EXPERIMENTS.

The tobacco work as outlined in previous reports has been continued during the year. This work has been carried on in the Connecticut Valley, Florida, Texas, Alabama, Kentucky, Tennessee, Ohio, New York, Maryland, and Virginia, the object being to secure improved types by methods of breeding and selection, and to fix these types and establish them, to demonstrate the best means of growing the crops in the various regions, to accomplish the wide distribution of seeds of improved types, to introduce rotation and diversification, to aid in maintaining the fertility of the land where tobacco is made a specialty, to study various diseases, and by work in the laboratory to solve important points concerning the questions of burn, aroma, etc. The work in the Connecticut Valley has placed the industry on a new basis, it having been conclusively demonstrated that the varieties originated are eminently adapted for culture under shade and in the open field. The culture of tobacco under shade in the Connecticut Valley has been put on a profitable basis by the growers through the use of the Hazlewood Cuban tobacco, an extremely uniform variety adapted for culture under shade in this valley, and the use of improved methods of culture, the result of experiments and experience.

Important work has been continued in the matter of securing cover crops for the tobacco fields during the winter. Several years ago hairy vetch was introduced into this section, and it has been demonstrated that this crop adds about $18 per acre of nitrogen to the soil, and its value, both as a fertilizer and for improving the humus condition and the physical condition of tobacco lands, is estimated to be worth at least $35 per acre.

In Florida fourteen tobacco breeding fields have been conducted with individual growers. These fields are located so as to secure variety in cultural conditions, soil, and other things. In Texas the work has been mainly in connection with pushing the work of growing wrappers and cigar fillers. Assistance has been furnished growers in the way of expert advice as to methods of culture, curing, and fermentation of the crop. About 75 acres of shaded tobacco and 250 acres of Cuban filler types have been grown in the State. In Alabama the work has been with cigar filler and wrapper tobacco. In Kentucky and Tennessee extensive breeding work and fertilizer tests have been continued with the various types grown there. Similar work has been carried on in Ohio and New York. In addition to the definite experimental work under way in the different tobacco sections the Department is cooperating with a large number of individual tobacco growers who have taken up the systematic improvement of established varieties of tobacco.

An extensive system of fertilizer experiments, which in some cases have now been going on for four years, has been conducted in a number of locations in the States named and on all varieties of soils, and indicate how readily soils known to produce about 800 pounds of tobacco to the acre can be improved so as to produce 1,400 to 1,600 pounds per acre and at a greatly increased net profit. At the same time the work has demonstrated the value of rotations and fertilizers in building up and maintaining the fertility of the land. Fine crops of 2½ to 5 tons of hay per acre have been grown in rotation with tobacco and other crops. This work is being done in cooperation with State experiment stations, all of which are contributing liberally in the matter of expenses involved.

WORK OF THE PLANT PATHOLOGISTS.

Orchard-fruit diseases.—Studies of orchard-fruit diseases have been continued along a number of lines. In California the Bureau has continued to give expert assistance to the California growers in combating pear blight. The California growers and the State and county horticultural commissioners and the State experiment station are cooperating with the Department in this work. Pear blight during the past year or two has invaded the fine pear orchards of the Rogue River Valley in Oregon, and the Bureau pathologists were called there to assist in the effort to stamp out the disease or control it. Important work has been carried on during the year in connection with the little-peach disease and peach yellows, the winter injuries of fruit trees, the gumming fungus of the peach and other stone fruits growing in California and other Pacific Coast States, and certain injuries to apple and peach foliage as a result of spraying with Bordeaux mixture and other fungicides.

Diseases of truck crops.—The great development of the trucking industry along the Atlantic and Gulf coasts has brought with it a host of new problems for investigation. The growers rely almost entirely on commercial fertilizers for the production of their crops, and some have used them exclusively and in excessive amounts until distinct nutrition diseases have appeared and caused much loss. The Bureau is studying these malnutrition problems and has already shown that by a suitable modification of the fertilizer formulas, together with the use of lime, stable manures, and green manures, the diseases may be prevented. Potato spraying—an established practice in Northern States—has not come into use in the trucking sections. The Department is adapting methods and practices to local conditions, to the end that better control of all potato diseases may be had. Similar work is being done with cucumbers, cantaloupes, and other truck crops grown extensively along the Atlantic coast.

Disease-resistant cottons.—The increase and further improvement of the wilt-resistant Upland cottons mentioned in previous reports continue to receive attention. The distribution of several hundred bushels of seed has resulted in the general introduction of these varieties into infected districts. We now have under way selections designed to be adapted for boll-weevil conditions. Special attention is called to the desirability of practicing crop rotations for the control of root-knot in the South and to supply something to take the place of the ordinary cowpeas, which must be avoided in such rotations, and wilt-resistant and root-knot-resistant varieties have been developed.

IMPROVEMENT OF CROPS BY BREEDING AND SELECTION.

Work on corn improvement.—Gratifying results have been secured during the past year in the breeding of improved strains of corn. The breeding work has been conducted so as to cover a wide range of territory, extending from the most southern through the central and into the most northern States. As a result of the work the past three years a high-yielding strain of corn showing remarkable adaptability to dry-weather conditions has been developed in Texas. This strain has proved of value in Arizona and other parts of the Southwest.

The breeding of strains of corn for increased yield, greater uniformity, and adaptation to soil conditions in localities where grown has been continued at points in Tennessee, Virginia, Maryland, and Ohio. At all of these points the Department selections have shown their superiority to the strains commonly grown. In Virginia during the past year fields grown from one of these selections produced from 90 to 100 bushels per acre, which was about one and one-half times the average yield in the community where the crop was grown.

In Wisconsin the Department has developed a high-yielding early-maturing variety that produced last year during an unfavorable season 100 bushels to the acre.

Breeding experiments have been started the present year in California, Nevada, and Arizona to secure strains adapted to the peculiar conditions prevailing in those localities.

The work in the improvement of sweet corn has been continued, and several high-yielding strains of excellent quality have been developed as the result of work in New York, on the Arlington Experimental Farm in Virginia, and elsewhere.

Farmers' cooperative breeding work.—With a view to bringing the results of the breeding investigations of the Department home to the farmer in such a way that he can adopt the practices which the Department has been perfecting, extensive cooperative work has been inaugurated in a number of Southern States. Cooperative breeding work with several types of cotton and corn was conducted with a number of farmers where the conditions were favorable for the development of new and improved varieties of these crops. Two distinct and new types of corn and six of cotton have produced such marked increase in yield per acre as to demonstrate their value for this work. These types have been adopted by the cooperators for extensive breeding work next season.

SUGAR-BEET INVESTIGATIONS.

Investigations regarding sugar-beet growing have been continued during the past year along the same lines as indicated in previous reports. Special efforts have been put forward in connection with the growing of pedigreed strains of sugar beets, this work having been carried on in several States. Further comparative tests with American-grown seed and the leading varieties of imported seed have been conducted on a commercial basis with encouraging results, the amount of sugar produced per acre being somewhat greater in the case of the American-grown seed than in any of the imported varieties. The field work in the use of commercial fertilizers in connection with the growing of sugar beets is still under way. Further work is also being carried on in connection with effective cultural methods, the objects being to determine the most satisfactory depth of plowing, width of row, manner of cultivation, and other operations in connection with growing beets.

PURE-SEED INVESTIGATIONS.

The pure-seed work has been extended during the past year by the establishment of testing laboratories in cooperation with the Nebraska Agricultural Experiment Station and the Missouri Agricultural Experiment Station. At the laboratory in Washington, D. C., a larger number of samples of seed have been tested for farmers and seedsmen than in previous years. As directed by Congress, forage-plant seeds have been secured from dealers and examined for the presence of adulterants. Many lots of Kentucky bluegrass and orchard-grass seed have been found to be adulterated, but the practice of adulteration has practically ceased with other forage-plant seeds.

The efforts of this Department in encouraging the use of good seeds are being appreciated, and a reflection of this is seen in the fact that several of the larger seed houses have recently established private seed-testing laboratories. On account of the lack of instruction in technical seed testing in the agricultural colleges this Department has offered assistance along this line. So far a number of seedsmen, as well as State agricultural experiment station workers, have availed themselves of this opportunity.

DRUG AND POISONOUS PLANT INVESTIGATIONS.

WORK ON DRUG PLANTS.—This work has for its object the establishment of new industries in the line of growing certain crops as drugs. In a previous report attention was called to the success attained in establishing the camphor industry in Florida. Further work has been pursued in this field, seed beds having been constructed and a considerable quantity of seedlings started for transplanting to the field. Certain regions of the South have been found particularly adapted to the production of drug and similar crops.

Some important investigations in connection with hop growing have also been carried on during the year; also important work in the line of growing tannin crops. Closely allied with the tannin problem is that of vegetable dyes, which is receiving attention in this connection.

POISONOUS-PLANT INVESTIGATIONS.—During the past year the main emphasis has been laid on the loco-weed studies. Field studies have been continued having for their object the working out of methods of diminishing losses not requiring individual treatment. Thus far the results have not been promising. A laboratory study of the loco weed seems to show that barium is a constant constituent in loco plants which are capable of producing the disease. Feeding experiments have led to the conclusion that barium poisoning is one of the factors that has to be reckoned with in dealing with losses from loco weeds. A study of the distribution of barium in the soil and in the loco-weed flora of eastern Colorado has been begun in cooperation with the Bureau of Soils. At the request of the Forest Service special investigations were undertaken of poisonous plants growing in the National Forests. Botanical studies of the flora of the regions suspected to contain poisonous plants have been inaugurated. Plants of unknown characteristics suspected of having toxic properties are forwarded to Washington for laboratory investigation.

CROP TECHNOLOGY.

A number of important lines of investigation recently inaugurated by the Department have, owing to their close relationships, been grouped under the general head of crop technology. Certain important biological studies of grains come within this category; also the new work authorized by Congress on cotton standardization and fiber investigations.

Cotton standardization.—The subject of cotton standardization has received careful attention ever since the agricultural committees of Congress first began to give the matter consideration. Good progress has been made toward establishing the nine official standards directed by Congress. The different American and foreign cotton exchanges have responded generously to an invitation to assist in this important matter. These numerous exchanges have contributed their standards free of cost, thus insuring an extensive collection as data for the establishment of official grades. The work undertaken in connection with this important project gives full consideration to all the problems involved in the raising, picking, ginning, baling, warehousing, grading, pressing, shipping, and spinning of cotton, and at a later date it is confidently expected that the official standards will be elaborated without alteration of their fundamental character, so as to be much more useful than any standards have ever been in the past. The possibility can now be clearly seen, through technical examination of the cotton fiber of this country, of so improving cotton classification that all interested in the cotton industry will be materially benefited. Careful studies have been made of the baling and handling of cotton, and a bulletin on the subject has been prepared. The present methods of baling and handling entail an annual loss of millions of dollars. The investigations along this line, together with the adoption of uniform grades, should result in great improvement.

Paper manufacture.—With reference to the paper work, under special authority given by the last Congress a comprehensive series of tests is being undertaken in conjunction with the Forest Service and the Bureau of Chemistry, the object being to ascertain whether or not the fibrous portions of various crops can not be more generally utilized in the manufacture of paper. In this series of tests corn, rice, and flax are receiving prominent attention. It is too early to make a full statement, but the results already obtained are regarded as promising.

FRUIT INVESTIGATIONS.

Important work in connection with the pomological collections and other investigations of this nature has been carried on during the year. The Department receives many hundreds of requests for help, all of which are cheerfully met. The identification of fruits and the resulting correspondence occupy a great deal of time. More than 2,500 specimens of fruits were received for identification, including rare and little-known fruits from recently annexed island possessions. More than 50 varieties of fruits were disseminated to fruit growers and horticulturists for trial during the year.

Fruit marketing.—The investigation of the problems involved in the marketing, transportation, and storage of fruits has continued during the year, the work being shaped to conform to the rather abnormal crop conditions that prevailed during the season of 1907. Notwithstanding the low quality of the winter apples throughout most of the eastern apple districts, the export movement was heavy, and under existing market conditions again demonstrated its importance to the apple industry by affording an outlet for surplus supplies. The season's experience resulted in a renewed interest among growers and shippers in the subject of grading and packing winter apples.

Handling and shipping California oranges.—The work on orange handling in California was vigorously prosecuted along lines previously discussed, with a view to accumulating sufficient data under varying conditions to permit safe generalization. In this work nearly 300 experimental shipments from California to the Atlantic coast were made in cooperation with individual orange growers and cooperative associations to determine the influence of different methods of handling upon the behavior of the fruit while in transit and after its exposure in the market. The results of this work in connection with that of former years establish conclusively that it is practicable to handle the orange so carefully on a large scale that decay in transit and for a reasonable time after arrival in our eastern markets can be practically eliminated.

Florida orange work.—The results of the work on orange handling in Florida, which has followed the general lines developed in California, indicated that the need of careful handling and prompt shipment after harvesting of the fruit from that State is even greater than with California fruit. The indications are that the losses there, which amount to a half million dollars a year, can to a considerable extent be overcome by handling the fruit with sufficient care to avoid mechanical injury. The work is receiving hearty cooperation from the growers and shippers of the State.

Fruit storage.—Comprehensive tests of the behavior of apples in storage from different producing sections in New York, Iowa, Colorado, and California have been continued with a view to determining the best methods of handling the fruit to insure the longest keeping in sound and wholesome condition. Strikingly important results have been obtained in the storage of a number of varieties of table grapes in California, which it has been found possible to hold from sixty-five to one hundred days in excellent condition when packed in fine ground cork, where similar fruit packed in the ordinary commercial way could be held but from ten to twenty days. The possibility of displacing the present large importation of foreign grapes for winter use with fresher fruit of better quality and of American production renders this work of special importance to American grape growers.

Pecan culture.—Comprehensive studies of the adaptability and relative value of pecan varieties in the Southern States have been commenced, many problems requiring attention having come to light in connection with this rapidly developing new industry.

THE PASTURING OF RANGE SHEEP IN COYOTE-PROOF INCLOSURES.

An experiment in the pasturing, as opposed to the herding, of range sheep has been in operation during the past season, conducted jointly by the Forest Service and the Bureau of Plant Industry. The results of the experiment are of great significance in their bearing on the increase of the carrying capacity of the great sheep ranges in the Western States and on the improvement of range mutton and wool in amount and quality.

The experiment was located at Billy Meadows, in the Wallowa National Forest in northeastern Oregon, a district infested with coyotes and other wild animals. An area of 2,560 acres of mixed forest and grass land was inclosed with 8 miles of woven and barbed wire fence believed to be coyote-proof. The inclosure was cleared of coyotes in the spring and a band of ewes and lambs numbering 2,209 was turned loose within it. They were not herded, but were left entirely free to make their own choice of feed, watering places, and bed grounds.

The experiment was a success in every way. Although coyotes came up to the outside of the fence nearly every night during the summer, not one of them succeeded in entering the inclosure. The sheep spent the whole season in almost absolute quiet, without any molestation by wild animals.

Still more significant was the condition of the sheep at the end of the season. The pastured band was made up of original Merino stock bred for six years to Rambouillet bucks. The sheep were therefore of a pure fine-wool type. The average weight of the lambs at the age of 6 months was 72 pounds. Individual lambs weighed 90 pounds. In the unfenced range immediately adjoining the pasture a band of sheep of similar class and grade was grazed during the season under the customary herding system. This range was exactly similar to that in the pasture and had the advantage of being a little less heavily stocked. The lambs of this band averaged 62 pounds, 10 pounds less than the pastured lambs.

In the matter of carrying capacity a still greater economy was effected. A comparison of the pasture with the ranges of five bands immediately surrounding it indicates that the carrying capacity of the land was increased 50 per cent, at a conservative estimate, by the pasture system.

GRAIN STANDARDIZATION.

Since the publication of my last annual report an unusual development has taken place in the work of grain standardization. The results already accomplished have been of value in bringing about a better understanding concerning the value of the various factors which are taken into consideration in determining the grade of any given lot of commercial grain, and have led to the formulation of more definite and satisfactory rules on grades in many of the markets.

Grain standardization laboratories.—Seven laboratories are now maintained outside of Washington, one at each of the following grain centers: Baltimore, Md., New Orleans, La., New York, N. Y., Duluth, Minn., Minneapolis, Minn., Chicago, Ill., and St. Louis, Mo. Numerous requests for the establishment of laboratories in other important grain markets have been received, but the limited funds available for this work rendered the opening of additional laboratories impossible; consequently the work has been limited to the primary markets, embodying the widest range of conditions and showing the greatest variation in the kinds and classes of grain handled. In each of the laboratories now in operation the work consists principally in determining the moisture content and in making mechanical analyses of samples of grain submitted by grain inspectors and merchants, and in carrying on such special investigations in cooperation with the research laboratory which is maintained in Washington as will furnish data of value in adjusting the unsatisfactory conditions now existing in the grain trade throughout the United States. The moisture test is most frequently called for, and large quantities of corn are now handled on a definite percentage statement of moisture content. A number of cases have been reported in which the results of the analyses furnished by the laboratories have determined the action taken in appeals and otherwise served in the satisfactory adjustment of grades.

Grain transportation and storage investigations.—Within the past year some preliminary investigations were made on the changes which take place in grain while in storage and during shipment from country points to primary markets or to the seaboard. These investigations will be carried on more in detail during the coming year, giving special attention to the causes of the deterioration of corn during transit from the central part of the corn belt to the seaboard and thence to European ports.

Inspecting and grading commercial grain.—While many of the influential grain dealers of the country are working hard to bring about a more satisfactory and uniform system of inspecting and grading grain in the various markets, it is believed, as stated in my last annual report, that the end to be attained can be brought about only through National inspection of all grain entering into interstate and foreign commerce.

Measuring moisture content by electricity.—As a result of work conducted by the Bureau, an electrical method for the rapid measurement of the moisture content of grain, requiring only two or three minutes for a determination, has recently been devised. This method can be used in cars and elevators and will doubtless prove of great value in connection with the grading of grain.

DRY-LAND AGRICULTURE.

This important work, inaugurated several years ago by the Bureau of Plant Industry, is being pushed as rapidly as the means at hand will permit. The work covers three principal areas: (1) The Great Plains region; (2) the southwestern section, including the dry portions of Texas, New Mexico, Arizona, and California; and (3) the intermountain region, including the Great Basin of Utah and the arid lands which can not be irrigated throughout the mountain States of the West. A number of the branches of the Bureau are contributing to the work and all are in close cooperation.

Stations for the investigation of dry-land conditions.—Eleven stations have been established in the Great Plains area where carefully planned scientific investigations are being carried on to determine the best methods of tillage, rotation, and crop sequence. Seven of these stations are in cooperation with the State experiment stations of Montana, North Dakota, Nebraska, and Kansas. Four of them are not in cooperation with the State experiment stations and are located in South Dakota, Colorado, and Texas.

FARM MANAGEMENT.

The work which has now been carried on for several years under the general head of "Farm Management" is growing in importance and value. Its object, as previously explained, is to bring together and carry to the man on the land the best knowledge of how to make agriculture more profitable and at the same time conserve or build up the fertility of the soil. Research and experiments are not a part of this work, but the results secured in this field by the Department and the experiment stations are applied. The work is distinct from that of cooperative farm demonstrations, as explained under another heading, in that the class of farmers dealt with have, owing to more fortunate surroundings, been placed in a position to undertake advanced lines in the general improvement of agricultural practices.

Work in the South.—The continued clean cultivation of cotton and corn in the South has destroyed the humus of the soil. Special attention has been given to methods of supplying humus. Improved systems of crop rotation and general farm management are being outlined and put into practice by many farmers who are cooperating in a very cordial way with the Department. Crops which have been secured by other branches of the Department are called to the attention of reliable men who are willing to test and try them, and in this way various cereals, forage crops, etc., have been quite generally extended. In handling work of this kind every important factor which may bear on the successful production and handling of the crop must be taken into consideration. Alfalfa is being advocated in a number of sections with excellent results.

Work in the Middle West.—The continued advance in the price of land is having a marked effect on the systems of farming. In addition, the exhaustion of the soil under exploitive systems of farming has brought about radical changes. A special line of work conducted during the year has for its object the investigation of the possibilities of introducing successful agriculture in the jack-pine plains of Wisconsin, Michigan, and Minnesota. These lands are wild and sandy, and under ordinary methods of cropping are not profitable. Certain systems of farming, involving the growing of clover for seed, are found profitable in the region. A bulletin outlining this important line of work has been published.

Work in the Plains Region.—With a view to rendering assistance to the many people who are giving up their farms in the more humid regions and securing cheaper lands in the dry sections of the West, studies of successful farms in these drier regions are being made. During the present year the Department has been making a careful study of the experience of a number of farmers who have remained on the land since the first settlement a generation ago. Some of them have worked out satisfactory methods of farming in regions where farming generally has not been successful. The experience of these men will be brought together and published in the near future for the benefit of others who are trying to make a living under these adverse conditions.

FARMERS' COOPERATIVE DEMONSTRATION WORK.

The object of the farmers' cooperative demonstration work now being carried on in the South by Dr. S. A. Knapp is to place a practical object lesson before the farmer, illustrating the best and most profitable method of producing the standard farm crops and to secure active participation in such demonstrations by the farmers themselves. It is an effort to teach the farmer to help himself through the influence of good local assistance, aided and guided by such means as the Department may find it necessary to supply.

The practical value of the work can be estimated by its growth. Congress has made a yearly appropriation for its maintenance in the States where the Mexican cotton boll weevil is present, and the General Education Board of New York, being impressed with the results, asked to cooperate with the Bureau in extending the work east of the Mississippi. Beginning in 1906, this Board has supported the eastern or " extension division " of the work, which includes the cotton States from Mississippi to Virginia, by an appropriation annually increased till the sum of $76,500 has been allowed for the year 1908–9. From one farm in Texas and one agent in 1903 the work expanded in 1908 to 32,000 farms with 157 field agents, covering portions of 11 States from Texas to Virginia, inclusive. In numerous cases, when appeals were made for greater extension of the work and there were not sufficient available funds to meet the added expense, counties or business organizations have cooperated in paying half or more of the salary of an agent. As organized under the Bureau of Plant Industry, its working forces consist of 1 director, with assistants, 10 State agents, and 147 district and local agents. Weekly reports are made by all agents to the director, showing work accomplished each day.

It is stated to the farmers that they can increase their crop yields two, three, or four fold at a reduced cost per acre, and that this may be almost a net gain by producing upon the farms the food supplies for family and teams. They are asked to prove it by working an acre or more according to directions. The necessary work on this part of the farm must be done by the farmer and not by a Government agent, because the whole object lesson is thereby brought closer to the people. The demonstrating farmer understands it better because he does the work. His neighbors believe that what he has done they can do. The agent makes monthly inspections of fields and gives additional instruction.

In order to promote the successful development of the new projects put under irrigation by the Reclamation Service, this Department has started experimental work on several projects in the Western States. On three of these projects small experiment farms have been established during the past two years. The use of the necessary land, water, and permanent equipment for these farms is furnished by the Reclamation Service, and the experimental and demonstrational work is carried on by this Department. The aim of these experimental farms is to secure thorough and careful trial of new plants that are introduced by the Department, to ascertain and demonstrate the tillage and irrigation methods best suited to each locality, and to provide a place for the special investigators of the Department to carry on field experiments along their particular lines. As an instance of the value of these farms in the introduction and establishment of new crops there may be noted the case of Egyptian cotton in the Southwest, an account of which is given on page 24.

ARLINGTON EXPERIMENTAL FARM.

The plan of soil improvement adopted in the management of the Arlington Experimental Farm is proving to be more effective than was anticipated. The work forcibly demonstrates the value of cowpeas and crimson clover as soil enrichers. The nitrogen gathered by these crops, together with the mechanical benefits obtained from turning under large quantities of organic matter, has transformed a cold, inert, and unproductive soil into one which is loose, friable, and productive. This work is of great value, because it demonstrates the method which any land holder in the South Atlantic States may follow to restore high productive power in his soil at small cost.

CONGRESSIONAL SEED DISTRIBUTION.

The Congressional distribution of seeds and plants was carried out along the same general lines as in previous years. The regular distribution of standard varieties of vegetable and flower seeds was made, and the cooperative distribution of selected varieties of cotton, tobacco, and other seeds developed by the Department was carried on with gratifying results. The work of packeting and mailing vegetable and flower seeds was seriously interrupted in November, 1907, by the almost complete destruction by fire of our seed warehouse. Congress promptly appropriated a sum sufficient to cover the loss, however, and the work was resumed about January 1, 1908, in temporary quarters. All of the vegetable and flower seed was distributed in ample time for spring planting in the various parts of the country, although the fire resulted in delaying the final shipments about one month beyond the usual time for completing the distribution.

FOREST SERVICE.

PROGRESS IN NATIONAL FOREST ADMINISTRATION.

Mastery by the Forest Service of one of the greatest practical forest problems ever undertaken by any Government is advancing apace. Briefly stated, that problem is to develop to its highest usefulness a total area of 168,000,000 acres of wild lands, mainly mountain wilderness, but closely related to the welfare of the entire West, and therefore of the entire country. The progress of the year was marked along both administrative and technical lines.

From an administrative standpoint the most striking fact of the year was the remarkable increase which took place in the volume of business transacted, or, in other words, in the actual use of the Forests by the public.

Regarded as property, the National Forests justify liberal expenditures for their protection and improvement. At $2 per thousand feet stumpage, the merchantable timber alone forms, just as it stands, an asset worth something like $800,000,000, while the very moderate grazing charge yielded the Government last year an income of nearly $1,000,000. It is a safe prediction that within twenty years the Forests will bring in from the sale of timber alone an annual net income of as many millions of dollars.

An average wood production of 30 cubic feet to the acre of commercial forest is a moderate estimate of what will ultimately be obtained under management. One hundred million acres of such forest would allow to be cut each year over 3,000,000,000 cubic feet, or from 20,000,000,000 to 25,000,000,000 board feet, without diminution of the supply. This is but a fraction of the country's consumption of wood at the present time, but at the stumpage prices which already obtain in the older and better settled parts of the United States its sale would bring the Government each year from $80,000,000 to $125,000,000.

WHY EXPENDITURES EXCEED RECEIPTS.

Were it wise to do so, the receipts from the Forests could very easily be made not only to keep pace with the expenditures, but to return to the Government the entire cost of maintaining the Forest Service. Private owners of grazing lands in the same regions ask and receive a very much higher return per head of stock for the use of their lands than does the Forest Service. The National Forests, which contain one-fifth of the standing merchantable timber in the country, furnished last year about 1.3 per cent of its lumber cut, resulting in the removal from the Forests of about one-eighth of 1 per cent of the stand. Of this comparatively insignificant amount cut, one-fourth was not sold, but was given to home builders and communities; yet the sales brought in nearly $900,000. If the chief object of the Forests were to produce immediate income, the amount received could be multiplied several times. There is actually going to waste in the woods each year, through decay and other natural causes, from five to ten times the amount of timber now being cut.

With an adequate force of Forest officers available much of this waste might be prevented. Timber sales involve, for marking, scaling, and supervising the work, a cost to the Government of about 30 cents per thousand feet, and the amount sold can not be much increased without an increased appropriation. There is also the waste of the productive power of the Forest, which can not be brought into full play until the mature trees have been removed to make room for a growing crop.

Yet other considerations are involved. Most of the National Forest timber is beyond reach unless heavy outlays are made to obtain means of transportation. Such timber can be sold only to those who command large resources of capital, and even then only at a relatively low price. On the other hand, where the demand for the timber is good and competition for its purchase fairly brisk, it is generally necessary to go slowly because of the certainty of future requirements. In short, the question of the timber that can safely or wisely be sold is a local one. The fact that timber is rotting in the woods in distant regions will not help communities which find their home supply exhausted.

For these reasons the sales of National Forest timber are carefully guarded. In consequence the receipts have for the time being lagged behind the expenditures. In 1907 the Forests brought in more than was spent upon them. In 1908 the expenditures exceeded the receipts by more than $1,200,000. The difference in the showing of the two years is a result of the recognized necessity of considering future needs in preference to immediate revenue. That the country may have timber when it will want it most, the Government is virtually investing the difference between the receipts and the expenditures, for it is not merely protecting the present merchantable timber from loss by fire, but is also increasing the stock of young trees which will make up the future Forest supply.

I am now restricting the sale of timber from the National Forests in accordance with a policy dictated by the public interest. The timber lands of the West, outside of the National Forests, are mainly in strong hands. Were the National Forest timber offered on the market to every purchaser, the main scene of western lumbering would be quickly shifted to the public holdings.

PERMANENT IMPROVEMENTS.

The agricultural appropriation act of 1908 included an item of $500,000, which was made available for permanent improvement work on the National Forests. The object of this work is to help open up the Forests to more use and provide means for their better and more economical protection, through the supply of means of communication and transportation, well-located field quarters, fire lines, fences to assist in the handling of stock, and watering places. These improvements are essentially investments of capital, which add greatly to the value and usefulness of the Forests.

The work completed during the year included 3,400 miles of trails, 3,200 miles of telephone line, 100 miles of wagon road, 40 miles of fire line, 250 bridges, 550 cabins and barns, and 600 miles of pasture and drift fences. In addition to the sum provided by the special-improvement fund, over $100,000 from the general fund of the Service was turned from current expenses to defray the cost of this work, but much of the work planned and urgently needed could not be carried out because there was nothing with which to pay for it.

THE ADVANCE IN TECHNICAL METHODS.

All timber to be cut is marked beforehand by the Forest officers. The efficiency of this work depends on the wisdom with which rules for marking are laid down and the skill with which they are applied. In both respects the work of the year bettered previous practice. Special marking rules for each National Forest were prepared and put in force. Where it was found that a shortage of the supply of timber for meeting local needs is to be feared, the marking system was modified to provide for the cutting only of trees which have made their full growth or are dying or diseased. Thus, the thriftier merchantable trees are left for a second cut from the same area within fifteen or twenty years. The selection of seed trees was improved, more complete use of the timber felled was secured, and more dead and low-grade timber was sold. In these and many other ways the standard of technical work on the Forests was raised.

The fire record also deserves mention. Since the fiscal year ends in the midst of the fire season, reports of fires are made not for fiscal but for calendar years. During the calendar year 1907 the loss of timber by fire was less than half that of the previous year. though this in turn was less than ever before. About one-seventh of 1 per cent of the Forests was burned over in 1907, with a damage so slight as to be practically negligible. The ratio of loss to the value of the timber protected, allowing that it is worth $2 per thousand feet, was about as 4 cents to $1,000. The entire cost of National Forest administration was equivalent to a charge of one-third of 1 per cent on the value of the timber protected—surely a cheap insurance rate.

THE NEED OF PRIVATE FORESTRY.

Ten years ago the Department of Agriculture offered, in pursuance of investigations in forestry, and in order to disseminate a knowledge of improved ways of handling forest lands, to cooperate with private owners through expert advice and assistance in planning and putting into practice forest management for their holdings. The investigations thus made possible were of the first importance. But for them the Government would have been altogether unprepared to undertake six years later the scientific management of the National Forests. They were in fact the foundation and virtually the beginning of practical forestry in the United States.

This offer has never been withdrawn. The work which its fulfilment involved was the chief cause of the rapid growth of the Forest Service between 1898 and 1905. Since 1905, however, the necessity of providing first of all for the needs of the National Forests has compelled curtailment of expenditures for general investigations, since neither men nor money have been available to carry them on.

NATIONAL FOREST ADMINISTRATION.

The number of National Forests under administration at the beginning of the year was 169, and at its close 182. In both cases the only National Forest not under administration was the Luquillo, in Porto Rico. The administrative, executive, and protective force numbered 1,512 at the beginning of the year, and 1,961 at the end.

Certain lands within National Forests are covered by unperfected claims. Under the general land law such claims can be initiated only under the mining laws, or for land which is found by the Secretary of Agriculture to be chiefly valuable for agriculture, and which is recommended by him to the Secretary of the Interior for listing for settlement and entry. Claims initiated before the National Forests were created, mining claims, and claims for agricultural land listed as above may be perfected in exactly the same manner as claims for lands outside of the Forest. All questions of compliance with the land laws are by law within the jurisdiction of the Department of the Interior. Since the duties of the Forest officers require them to be familiar with the land embraced within National Forest claims, the Secretary of the Interior has requested this Department to make reports of such conditions, and Congress has authorized the Forest Service to assist the Department of the Interior by ascertaining and reporting the actual facts on the ground. Since few Forest rangers have a practical knowledge of mining, the Forest Service has called to its assistance geologists from the United States Geological Survey, and has employed mining engineers and practical miners to make reports upon mining claims. During the past year reports were made to the General Land Office on more than 6,000 claims for lands in

National Forests. Of such reports 76 per cent were favorable. Action by the General Land Office, which resulted from reports made for several years previous, resulted in the cancellation of invalid claims to 50,000 acres of land bearing over 330,000,000 feet of merchantable timber. Every precaution is taken to avoid injustice to those holding claims. The claims which have been canceled by the Department of the Interior are those which were made for speculative purposes, and not for the permanent development of the lands. This work of examination is producing good results and is promoting the bona fide development of farms and mines. It increases the burdens which rest upon the National Forest force, but the expense to the Government occasioned by such examinations is repaid many times by the land and timber saved from speculative and fraudulent claims.

Examinations of lands under the act of June 11, 1906, led to the listing for settlement of about 240,000 acres of National Forest land.

The amount of National Forest timber sold during the year was slightly over 386,000,000 feet, or not much over one-third the amount sold the previous year. The falling off was directly due to the refusals to make large sales. Under such sales the actual cutting is allowed to extend over several years. The amount of timber cut and paid for during the year, however, more than doubled the cut of the previous year, with a total of not quite 393,000,000 feet. The receipts from timber sales were about $850,000, as against not quite $670,000 for the previous year. In addition there was cut under free use over 130,000,000 feet of timber, valued at about $170,000.

Reforesting of large areas of the National Forests is called for primarily in the interest of the water supply of the West, but also, though less pressingly, for the sake of an enlarged timber supply. Broadcast sowings were made during the year in 27 Forests, in 8 States, to test by experiment the extent to which reforestation may be hoped for through the use of this method. The National Forest nurseries in which are being grown stock for transplanting were enlarged and about 700,000 trees were planted. Over 2,000,000 trees will be ready for planting in 1909.

The beneficial results of regulated grazing, shown in a decided betterment of much of the National Forest range, made it possible to increase the allotment of stock on a number of the older Forests. At the same time investigations in range improvement through reseeding, new methods of handling stock, the eradication of poisonous plants, and the destruction of prairie dogs brought important progress toward still better future use of the Forests by stockmen.

BUREAU OF CHEMISTRY.

The report of the Chemist records the progress made during the first year of the execution of the Food and Drugs Act. The manifold difficulties in the organization and inauguration of such a work are apparent even upon superficial consideration of the subject; and, when one considers the scientific problems involved, the necessity of training the majority of the increased force, whether scientists or inspectors, and the double duty of securing justice for the manufacturer and the consumer alike, it is apparent that it is the part of wisdom to make haste slowly, particularly in regard to some decisions which are especially far-reaching in their effects. In putting the law into operation, every effort has been made to avoid working hardship upon any one. The decisions of the Board of Food and Drug Inspection as reached have been issued in a series of leaflets and have been widely distributed to manufacturers, dealers, and importers, that they might be aware of the attitude of the Department in regard to the points raised. At the same time much of the moral effect of the law depended upon a vigorous enforcement of its provisions, and such enforcement was plainly due the consumer for the protection of his health and his purse. It has been the endeavor of the Department to pursue a purely impartial and equitable course, giving due weight to all of these considerations.

INSPECTION UNDER THE FOOD AND DRUGS ACT.

A statistical statement of the samples taken and analyzed, seizures made, and prosecutions brought conveys practically no idea of the volume of work involved or the effect produced on the quality of food products. The number of branch laboratories has increased from 6, examining only imported products, to 21, analyzing both interstate and foreign samples. These laboratories are located at the following points, selected because of the control afforded interstate commerce: Boston, Buffalo, Chicago, Cincinnati, Denver, Detroit, Galveston, Honolulu, Kansas City, Mo., Nashville, New Orleans, New York, Omaha, Philadelphia, Pittsburg, Portland, Oreg., St. Louis, St. Paul, San Francisco, Savannah, and Seattle. The number of inspectors was increased during the year to 39 and approximately 13,400 samples have been collected and distributed among the branch laboratories and to the Division of Foods and the Division of Drugs of the Bureau of Chemistry. Inspectors are assigned to the branch laboratories and to such other points as afford an advantageous situation in regard to the interstate distribution of supplies. Of the samples analyzed and found to be adulterated, 814 were found to have been collected under such conditions that prosecution could be brought.

In addition, the inspectors have collected data necessary to institute proceedings for the seizure of 86 shipments for confiscation by a process of libel for condemnation. The shipments include cider, honey, coffee, flour, canned fruit, sirup, molasses, wine, meal, beer, vinegar, stock feed, and canned vegetables. These seizures usually represent large quantities of the products, as, for example, 135 barrels of cider, 40 cases of coffee, 2,240 sacks of flour, or 1,078 barrels of wine. In some cases the shipment was destroyed, for instance, 84 bags of coffee colored with lead chromate. In many other cases, where only misbranding is involved and this may be corrected by relabeling, the goods are returned to the owner upon payment of costs and the delivery of a bond not to dispose of the product contrary to the law. This feature of the law has not proved uniformly desirable, inasmuch as the manufacturer has in some cases failed to comply with the terms of the bond, necessitating an additional expenditure of labor and money for his reapprehension.

In addition to the collection of samples, the investigation of factories and work in cooperation with the chemists of the branch laboratories in conducting special investigations have played no small part in the activities of the inspecting force. The routine collection of samples of misbranded whiskies was supplemented by a special effort to locate large shipments of the product manufactured from neutral spirits and misbranded, under the decision of the Attorney-General, as straight whisky or blended whisky. Seizures have been made to the extent of 82 barrels and 6,702 cases, action in regard to the greater part of which is pending, and libel proceedings have been requested affecting 625 barrels and 31,359 cases of food and drug products.

SPECIAL FOOD AND DRUG INVESTIGATIONS.

A cooperative investigation in regard to the bleaching of flour and the use of durum wheat in flour milling was undertaken at the St. Paul, Chicago, and Washington laboratories, with the aid of the inspectors. In regard to the use of durum wheat, the leading millers were interviewed, the composition of 47 samples was determined, and a study was made of wheat mixtures affording information which had been much needed in regard to the branding of wheat flour. Seizures have been made and judgments obtained as to the misbranding of wheat flours which were mixed with flour from durum wheat and labeled hard spring wheat flour. The investigation in regard to bleaching flour was more extensive, as it called for a thorough study of the methods of grading and the results of baking tests, as well as chemical and physical examinations, before a conclusion could be reached. Over 1,000 determinations have been made in this study, and the investigation is nearing completion.

Special investigations, combined with factory inspection, have been made in regard to the canning of peas and the making of tomato ketchup. In the former case studies as to the grading of the product in connection with the question of proper branding have been made, and the effects of bleaching and the causes of spoilage have been studied. The ketchup experiments were made at a factory offered for the purpose, and included the manufacture of ketchup without preservatives, the causes of spoilage, the length of time elapsing both before and after opening when spoilage would take place, no preservative being present. Studies were also made of the antiseptic value of the spices, sugar, and vinegar employed. Methods of processing were also studied, and commercial brands were examined and compared with the experimental product. In connection with these studies it is of interest to note the increasing importance of the microscope in the detection of adulteration, the presence of bacteria, fungi, and other signs of fermentation and decay being easily demonstrable by micro-chemical examination.

The investigation of imported drugs involved the examination of 568 samples, representing many phases of adulteration and misbranding.

The examination of chemical reagents delivered to the Bureau of Chemistry is a very important item, underlying as it does the accuracy of the analytical work, and marked improvement has been effected in the quality of the chemicals delivered.

MISCELLANEOUS INVESTIGATIONS.

Numerous other investigations are in progress which are called forth by commercial conditions or are rendered necessary by the exigencies of the administrative work. The following are selected for comment as illustrative of the scope of the work:

POTABLE WATERS.—The extent to which mineral waters are being used rendered an examination of these products as they enter into interstate commerce advisable. Examinations accordingly were made of samples obtained at the sources of the waters and also as bought on the market. While it would be unfair to imply that the majority of these waters are sophisticated, nevertheless it has been found that a goodly number are contaminated in handling, as shown by the bacteriological findings, or are not true to label. The latter is especially apt to be the case in regard to mineral waters, the content of special constituents supposed to have medicinal value being very small. As bottled waters are depended upon for special purity and for use in illness, it is plain that a high standard should be maintained and the product should be true to label. The object of the investigation under way is to assure the public that potable waters in interstate commerce may be depended upon in these particulars.

UNFERMENTED FRUIT JUICES.—Experiments in the manufacture of unfermented fruit juices without the use of preservatives have been conducted on an extensive scale. Tests of methods of manufacture and of storage in glass, in tin, and in wood, including shipping tests, have been made, and it has been positively proven that palatable beverages may be made and may be kept by sterilization by heat only. This work is of interest both to the manufacturer and to the farmer, who can make profitable use of fruit products not marketable and which in most cases go to waste.

HONEYS.—A chemical and microscopical study of honeys of known origin and of commercial honeys had a direct bearing on the questions arising under the food law in regard to interstate samples. Careful studies of methods of analysis were made for the determination of adulterants, and the microscopical studies serve to identify the honeys as to their source by ascertaining from the pollen grains present the plants visited by the bees, the labels generally stating that the honey is from some particular floral source. Seizures of honey containing invert sugar and glucose have been made, and the data obtained in this investigation were needed for practical application.

COMMERCIAL ALCOHOL.—The study of the manufacture of industrial alcohol from the wastes of the farm and of sugar-producing plants has been inaugurated on a large scale. A plant manufacturing 75 gallons per day has been installed, and experimental runs, using corn, melons, small fruits, canning wastes, etc., will be made on a commercial scale. From these experiments it is expected that calculations can be made as to the comparative value of different wastes and materials for this purpose.

WORK IN COOPERATION WITH OTHER DEPARTMENTS.

While special investigations have for many years been conducted in cooperation with certain Departments, the practice of referring miscellaneous samples to the Bureau of Chemistry for analysis is constantly increasing, and there is hardly a Department for which some work is not done.

In regard to the drug work it is believed that the centers of propagation of fraudulent remedies and " cure-alls " have been broken up, and that in time this far-spreading evil will be practically destroyed so far as the mail service is concerned.

BUREAU OF SOILS.

To the Bureau of Soils is intrusted the study of the soil resources of the United States. There are three important steps in such a study. The first is to ascertain accurately by actual field investigation the extent, the location, and the boundaries of each and every distinct soil type in the country and to state its actual condition and efficiency as a factor in the annual production of new agricultural wealth. This work is being accomplished through the soil survey.

The second step is to ascertain those properties of soils, physical, chemical, and organic, which render each soil fitted to continue to produce profitable yields of crops, and to ascertain by what methods of cultivation, crop rotation, and fertilization the efficiency of each soil may be maintained and increased. This work is being done by the laboratories of soil physics, soil chemistry, and soil fertility.

The third step is to study all processes by which the actual soil substances are wasted or their properties essential to crop production are impaired, and to devise methods whereby such waste and impairment may be decreased or totally prevented. This work is being done through the investigations of the greatest source of soil wastage—soil erosion.

SOIL SURVEY.

The work of the soil survey was actively begun in 1899, when Congress first appropriated money for the purpose of making soil surveys. Since the inception of this work there have been surveyed 306 different areas in 44 different States and 2 Territories, exclusive of one area in Porto Rico. A soil survey is now in progress in one of the two remaining States, and one will be completed during the present fiscal year in the other State.

A total area of 157,078 square miles, or 100,529,920 acres, has been included in this work, and the Bureau of Soils maintains a field force of 62 men, working in different parties and completing detailed work in about 60 different areas, covering a total area of approximately 40,000 square miles each year.

In addition, reconnoissance surveys of 135,000 square miles annually are being conducted in the Great Plains and in the Appalachian Mountain and Plateau regions.

There are on file at the office of the Bureau of Soils requests for 478 additional soil surveys, covering nearly 500,000 square miles of territory.

A soil survey determines the exact character of the various soils, and their location and extent in each area is studied. It also ascertains their present use and capabilities by personal observation of the field force and the report of practical farmers owning and operating the soils and the farms investigated. It summarizes all of the present knowledge of these soils, whether obtained from the farmers who are cultivating them, from the chemical, physical, and fertility investigations of the Bureau's laboratories, or from the experimental and research work of the various State institutions concerned. It also enables all soil investigators and agricultural experimenters, as well as the farmers, to make direct comparisons between the soils of any one locality and of all others in the United States.

PROBLEMS IN THE USE OF SOILS.

The great problem of the northeastern States is so to utilize their soils that they may produce upon an intensive scale those crops which yield large returns per acre, which have a particular market value in the great seaboard cities, and which may be produced practically without competition from the more level central prairie States. The great variety of soils in the northeastern States and the fact that they have been farmed for two centuries practically to grass and grain crops makes it necessary to show the farmers of the section that these soils have other higher values than the production of the cereal crops and hay. Any change which may be brought about by this knowledge will be slow and gradual, and it is necessary first to demonstrate the desirability of such changes and then their possibilities.

In the South Atlantic States the problems are similar, except that large areas of unoccupied land still exist, and that the problem of the drainage of a portion of these lands along the coast and the determination of their crop value is paramount. Farther inland, in the Piedmont section, the prevention of soil erosion is one of the chief problems.

In the Gulf States the development of special industries along the coast is showing uses for lands which have previously been considered of little or no agricultural importance, and lands once held at a nominal value for their timber stand now have a greater value as agricultural lands even after the timber has been removed. This is largely due to the fact that their agricultural uses have been shown by a number of well-located soil surveys.

The problems of the central prairie States have in general been well worked out by the farmers of those States, and, until economic conditions in the United States change, the chief value of the soil surveys in the different States will be to enable the farmers to compare directly the best methods to be employed in the handling of their different soils. The other important problem is to determine the character of the soils in the vicinities of the large cities, in order that a local market-garden supply of vegetables and fruits may be raised near to the point of consumption. The greatest problem of the Upper Lake region is to determine the extent of agricultural lands and their uses in the cut-over timber belt.

In the far West the opening of Indian Reservations and the extension of irrigation systems annually make available for agricultural purposes large tracts of land about which there is little or no information, so far as the nature of the soil and its peculiar fitness for various crops is concerned. The change from extensive grain farming to intensive methods of agriculture in the fertile valleys of California and Oregon is likewise making available large tracts of land that under the changed conditions will support a population many times as large as formerly. Expert knowledge of the soil and its power to produce fruit and truck crops is essential to make such worthy enterprises successful.

All new tracts of land of this character are widely advertised and the cautious home seeker avails himself of all information that will enable him to make a wise selection of soil. In such areas where soil surveys have been made the reports are eagerly sought for, but the increase in the number of new and favorable localities in the fast-developing Western States emphasizes the necessity of making these additional soil surveys if the Department is to furnish this information to the farmer.

In Oregon and Washington, where the removal of the original forest growth has progressed sufficiently far to permit the farmer to engage in agriculture, the soils have yielded well all those truck and fruit crops which are in great demand in the Alaska mining districts. Additional surveys are needed in these northwestern forested areas to help the people to a better understanding as to just what these soils will produce.

The Bureau has continued active cooperation with the Reclamation Service in surveying the soils of the various projects under construction. This is likewise essential to the complete success of these undertakings on the part of the Government to make homes for the people in what are at present arid wastes.

RECONNOISSANCE SURVEY OF THE GREAT PLAINS REGION.

A noteworthy achievement just accomplished is the completion of a reconnoissance survey of an area of approximately 40,000 square miles in western North Dakota, in the Great Plains region. This region includes that portion of the country west of the one hundredth meridian and east of outlying ranges of the Rockies, extending from the Canadian boundary on the north to the Rio Grande on the south, and contains several hundred thousand square miles.

In my opinion this reconnoissance survey of the Great Plains should be vigorously prosecuted until complete knowledge of the soil conditions in the form of maps and reports for the entire region is available to all who wish to make homes in this section of the country.

LABORATORY INVESTIGATIONS.

The laboratories of the Bureau of Soils are maintained mainly for the support and aid of the field parties. During the past year they have accomplished a largely increased amount of detailed analytical work to this end, necessitated by the increasing activities in other branches of the Bureau's work. Besides this, however, the laboratories have continued their fundamental investigations on the relation of the soil to plant growth, some of the results of which it is proper to notice here.

It is now recognized that a farmer in handling his soil is in much the same position as the foreman of a factory, and to get the most out of his plant and raw material it is necessary to establish as perfect a control as possible of raw material, processes, and product. To obtain this control in the case of the soil, it is necessary to understand the fundamental relations between the plant, the soil, and the weather and similar conditions of environment, and the relation of one crop to another as affected by different types of soil, etc. In studying these problems it has come to be recognized that we must consider first three things: (1) The plant; (2) the soil moisture, which is the great food source of the plant; and (3) the mixture of solid mineral and organic compounds of the soil which determines the nature of the soil solution on which the plant feeds. These three things have this in common, that they are always more or less in motion. The sum of these movements is within a few years astonishingly large, and there is a profound change as far as the individual particles of the soil are concerned in every field, subsoil becoming surface soil, surface soil removed or replaced by materials from divers places, etc.

These movements which lie at the basis of soil fertility and crop production are all more or less readily affected by the three practical methods of control which human ingenuity has devised—cultural methods, crop rotation, and fertilizers or soil amendments. These movements in turn determine the physical, chemical, and biological conditions in any soil and its suitability for the production of any given crop or rotation of crops. Broadly speaking, the investigations of the laboratories of the Bureau of Soils aim to elucidate and make clear, and if possible give quantitative expression to the interrelations between these fundamental and natural soil phenomena and the known methods of control, with a view to improving the latter, reducing them to a logical basis, and removing them from the condition of empiricism in which they have so long remained.

The relation of the physical properties of the soil to the moisture content has been further studied. It has been shown that there is a critical moisture content where the water in the soil ceases to be entirely in the form of films over the surface of the soil grains and some of it is in the form of ordinary free water in the interstitial spaces. Laboratory methods for determining this critical moisture content, with precision, have been developed, and it is now a comparatively simple matter to determine this important datum for any given soil.

It has further been shown that the diffusion of heat into a soil (a most important factor in the germination and early growth of a crop) takes place most readily when the moisture content is slightly greater than the optimum, but is greatly retarded by a content much above or below this point. This investigation has also brought out important information regarding certain special methods of cultivation, as the flooding of cranberry marshes, etc.

In connection with the work on soil erosion which the Bureau is carrying on, a laboratory method has been devised for studying and comparing the erosiveness of different soils, and it now appears, contrary to popular opinion, that the soils of our Southern States are not inherently different from northern soils in this regard, but that the greater amount and extent of soil erosion observed in the South is due mainly to the torrential character of the rains and other climatic conditions peculiar to that section, and to faulty methods of cultivation. Practical methods for preventing and remedying erosion are now well understood, and there is a very gratifying increase in their use.

While the great carrying power of water in effecting the translocation of soil material is obvious, the importance of the wind in this connection has not been so generally recognized. Important movements of soil material by water take place only occasionally, and then in restricted areas, as along river courses, etc., while the wind is acting practically all the time and throughout the entire extent of land surface. An important and careful investigation has been made by the laboratories this past year, which shows among other things that the aggregate translocation of soil material by wind is many hundreds, perhaps thousands, of times that produced by water, and through incomparably greater distances.

An important and perennial subject of soil investigation is the organic matter in the soil known as "humus." Investigations of the physical and chemical properties of this substance have been continued during the year. It is a complex mixture, differing markedly in properties in different soils. The separation of the different components forming it has long defied the efforts of the chemist, but quite recently the laboratories of the Bureau of Soils have devised methods by which most gratifying progress is being made in this direction. It is not too much to expect that before many years the indefinite and rather meaningless term "humus" will disappear and we will speak of the different compounds forming it and their specific properties. Of these there appear to be two classes. The first includes the organic compounds common to most or all soils. So far as we now know these appear to have but little chemical or physiological effect on plants, but are mainly important for their physical effects on the soil. The substances of the second class are found in an individual soil or a few soils as a result of special conditions. Frequently these appear to have a profound and direct effect on plant growth.

In the fertility investigations of the Bureau of Soils some very important problems have been attacked and some very noteworthy results obtained which can not fail to be of the greatest value to further research in these lines and thus become of the greatest practical importance to the farmer. The soil investigator encounters many soils which do not respond to fertilizers, or if they have responded in the past, no longer do so at the present time, or at least require an entirely different system of fertilization from that necessary at the beginning. Fertilizers give in different seasons and in different years results which are not consistent but more or less erratic. The use of commercial fertilizers is constantly on the increase and conservative estimates place the expenditure at more than $100,000,000 annually.

It is this problem that has engaged the Bureau's attention for a number of years, and the extended use of commercial fertilizers in the United States makes it imperative that a thorough understanding of the action of fertilizers be obtained, for perhaps as much as a third of the money spent for fertilizers is annually wasted and brings no adequate return, owing to this lack of understanding of the soil's requirements. One of the most interesting results of this work has been to show that fertilizers have properties of improving soil conditions in addition to the plant food which they supply, and that in some cases this action may be of even greater importance as far as practical results are concerned than the plant food added. The Bureau's exhaustive studies in this difficult field have shown that in some of the unproductive soils this unproductivity is not due to the lack of any of the mineral plant foods, but is distinctly due to the presence of harmful properties which prohibit the plant from performing its normal functions when growing in the soil. The presence of these bodies in such soils has engaged the Bureau's attention for some time, and with the methods at its disposal it has been able to show that they exist, and that the soils and the extracts from these soils possess toxic qualities.

The most noteworthy advance in this work, and one which is of the greatest interest to practical agriculture, is that some of these bodies have now been actually isolated. They are not substances of mineral origin, but form a portion of the organic matter of the soil. It appears that in previous investigations of soils the organic matter has not been adequately considered, the investigators contenting themselves with determining the amount of organic matter present and the total nitrogen available in this organic matter. The researches of the Bureau therefore throw a great deal of light on the functions of organic matter in the soil. During the past year the Bureau has studied further this organic matter, with a view to determining its relation to the changes which are going on in every soil.

Other investigations of the Bureau during the past year have been the study of the influence of green manures and stable manure on plants and on the soil compounds. These researches have shown that properly decomposed green manure contains compounds which are beneficial to plant growth, aiding the plant to overcome any toxic conditions which may be in the soil in which it is grown to such an extent that a permanent effect upon the fertility of the soil is thereby brought about. The stable manure has been differentiated into organic and inorganic materials in the laboratory, and it has been shown that the organic materials have even greater influence in producing the healthful growth of crops than the mineral ingredients, although these aid materially.

The influence of bacteria on soil organic matter is another subject which demands further study, as the results so far obtained have shown that this action may be either direct or indirect, direct action resulting in the production of beneficial, harmful, or inactive organic compounds so far as crops are concerned, depending upon the conditions and the kind of bacteria at work. Bacteria also have an indirect effect, producing such products as ammonia, nitrites, and nitrates, and these affect the organic compounds of the soils. Still other factors of a biochemical nature must be taken into consideration. Experiments indicate a very strong influence of molds in the production of some of the bodies already isolated from the soil.

BUREAU OF ENTOMOLOGY.

The work of the Bureau of Entomology has increased in scope and efficacy during the year. Admirable progress has been made in investigations under way, and certain new topics have been taken up.

WORK ON THE GIPSY MOTH AND THE BROWN-TAIL MOTH.

The work of the Bureau against these two injurious insects in New England has consisted largely in clearing up the thoroughfares leading from the most seriously infested localities by destroying the underbrush, removing poor trees, and burning all débris for a strip of 100 feet on each side of the road. The forests in many places in Massachusetts are seriously infested, and the method just described renders them comparatively innocuous as centers of distribution, since the roads through these forests are so clean that the caterpillars can not drop upon passing conveyances and thus become distributed over large areas. Scouting has been continued in Connecticut, Maine, New Hampshire, and Rhode Island, and every effort has been made to prevent incipient colonies from becoming dangerous centers. Extermination has been aimed at where possible, and prevention of spread where the colonies are larger. Work against the brown-tail moth has been carried on only along roadsides where work is being done against the gipsy moth. In Maine, Massachusetts, and New Hampshire there are State laws requiring property owners in cities and towns to care for this pest, and in those States occasional advice to property owners with regard to the removing of the winter webs is the main effort of the Government workers. One hundred and thirty miles of road in the State of Massachusetts has been cared for during the year in the way of cleaning up the border strips, both by banding trees and by spraying. The conditions in New Hampshire have been shown by scouting to be more serious than has hitherto been suspected, but in Connecticut, Maine, and Rhode Island extermination is still a possibility. The work has been admirably done, and commands the commendation of officials and citizens of the States in question.

IMPORTATIONS OF USEFUL INSECTS.

The main work in this direction has been a continuation of the large-scale efforts to introduce and acclimatize foreign parasites of the gipsy moth and the brown-tail moth in cooperation with the State of Massachusetts. Additional expert assistants have been stationed at the headquarters at Melrose Highlands, Mass., and a large amount of European parasite material has been brought over and in much better condition than in previous years. An expert has been sent to Japan who has organized an efficient service among the Japanese entomologists and has secured the sending to this country of many thousands of parasites belonging to several different species. At the parasite laboratory new methods have been devised, and it has been shown to be possible to breed both the European and Japanese parasites in large numbers in artificially heated rooms, and thus to liberate them in infested woodlands in much greater numbers than before. These discoveries reduce the expense of the experimental work and at the same time increase its efficiency. During the summer of 1908 more than 200,000 specimens of the most active foreign enemies of both gipsy moth and brown-tail moth have been imported and liberated under the most favorable conditions. In all 51 species of parasites and predatory enemies have been introduced, and all secondary parasites have been destroyed. Of the 59 species imported, there is sufficient evidence that 7 species have thoroughly established themselves. The probabilities are that many more have succeeded, but thus far it has been difficult to determine this point. There has been during the past year a tremendous destruction of the larvæ of both brown-tail moth and gipsy moth from bacterial and fungous diseases, and these diseases have in many localities killed off the parasites as well. The outlook for ultimate success is more favorable at the present time than at any period during the progress of the work. There seems no doubt whatever that eventually these imported parasites will multiply to such an extent as to render the gipsy moth and the brown-tail moth no more harmful than many of our native leaf-destroying caterpillars, but the experts of the Bureau of Entomology can not fix the date at which this desirable condition will be brought about.

MEXICAN COTTON BOLL WEEVIL.

The work against this important pest has shown a number of promising features during the year. It has been found that native parasites are becoming much more effective in controlling the weevil. During the season the average parasitism has been shown to have doubled in Texas and trebled in Louisiana. Work has been carried on in the introducing of parasites from one region to another, with the result that in several cases the effectiveness of parasites has been greatly increased by the introduction of material from other regions. Studies of a native ant which is increasing in efficiency as a weevil enemy have resulted in the discovery of an especial method of attracting these ants to substances in which they will build their nests and in which they may be transported in enormous numbers into regions where they are not abundant.

An important apparatus for the control of the weevil has been invented and a patent granted thereon. At the instance of the Department of Agriculture this patent has been dedicated to the use of the public. The invention consists of series of chains attached to a light frame in such a way that when dragged between the rows the fallen cotton squares infested with weevils are removed from the shade of the plants and brought into a narrow pathway between the rows, where they are exposed to the direct rays of the sun. This destroys and very greatly increases the mortality of the weevils in fallen squares. The same machine has a very useful cultural effect—it fills up the cracks in the soil and establishes a perfect dust mulch.

It has been shown in the Mississippi Valley that the basic method of destruction of the weevil by the fall destruction of the cotton plants becomes even more important than it was in Texas. The large-scale demonstrations of the importance of this operation carried on by the Bureau of Entomology have been widely advertised in the Mississippi Valley, with the result that during the present autumn great interest was shown by the Louisiana planters, and in one parish more than 40 per cent of the planters undertook the fall destruction of plants, which gives great promise for the success of their crops the coming year.

INSECTS INJURIOUS TO FORESTS.

Extensive field investigations have been carried on in the National Forests of northern and central Utah, northeastern Oregon, southern Arizona, southern New Mexico, and throughout Colorado to determine additional facts regarding the distribution of the principal insect enemies of the Rocky Mountain forests.

It was determined by a thorough inspection during the last year that the efforts of private owners and forest officials during 1905–6 to control the alarming outbreaks of the Black Hills beetle in 1904–5 in the vicinity of Palmer Lake and Colorado Springs and the adjoining Pikes Peak National Forests, under the advice of the Bureau of Entomology, were a complete success. It was also demonstrated that, in the same way, the efforts of the owners of an extensive private estate in Colorado to control the depredations of the same insect were equally successful. The first of these was accomplished by the cutting and barking of 1,000 trees, the products of which paid a large share of the cost and resulted in the protection of timber valued at more than a million dollars. The second was accomplished by the cutting and barking of less than 500 trees, resulting in the protection of timber of perhaps even greater value than in the first example. The real value, however, of these two examples of successful control is far greater than that represented by the money value of the timber protected, since they demonstrate, first, that the most destructive enemy of the pine forests of the central Rocky Mountain region can be controlled at a comparatively slight cost, or even at no expense, whenever the timber can be utilized, and, second, the absolute necessity of expert advice as a guide toward doing the right thing at the right time and at the least expense.

INSECTS DAMAGING DECIDUOUS FRUIT TREES.

An investigation of the pear thrips was begun in the fiscal year, and a field station for this purpose was located near San Jose, Cal. Careful life-history studies were made, and special attention was given to experiments in the field with methods of control. Various sprays were tried, and two of them give promise of efficacy—namely, tobacco extract and distillate emulsion.

Comprehensive investigations of the peach-tree borer and the plum curculio have been carried on at various points and demonstration field work against the codling moth has been under way at various points. Investigations and experimental demonstrations against the grape rootworm in the Erie grape belt have been practically completed, to the satisfaction of the vineyardists and to their great advantage. Studies have been made in connection with the serious outbreak of two species of bark beetles in the peach orchards of Ohio and of the grapevine Phylloxera in California. Further than this, an interesting and important investigation has been carried on relative to insects affecting drying and dried fruits in California, to determine the effect that sulphuring may have in affording protection against insect infestation.

FIELD CROP INSECTS.

The great damage done by the so-called " green bug " in 1907 was the occasion for the beginning of a very extensive investigation to ascertain its life history and possible remedies. During 1908, however, no comparable outbreak occurred. By the end of June, over its entire range, from Texas to the Canadian border, the insect was present in limited numbers and apparently awaiting only favorable weather conditions to become again destructive. These conditions did not recur, and there was therefore no opportunity for large-scale remedial experimentation. A careful study of the insect over the greater part of its range has been made, with the result that facts have been obtained which will prove of practical value another season.

Extensive wheat-sowing experiments have been carried on again in investigations of the Hessian fly. Valuable information has been gained, and the advice of the Department experts has resulted in the avoidance of much damage in several different localities. Further experiments in the transfer of parasites from one portion of the wheat belt to another have resulted in the complete saving of threatened crops, but a just estimate of the value of these experiments can not be formed until another season.

INSECTS INJURIOUS TO VEGETABLE CROPS.

During the year additional work has been done on the insects affecting truck crops in Texas, Florida, and southern Virginia. The opportunities offered by this localized work in the way of experiments on a large scale in the field have shown that nearly all of these insects can be economically controlled. Insects affecting the sugar-beet industry in the West have been studied in cooperation with the State Agricultural Experiment Station of Utah, and an agent has been located in California to continue these investigations.

INVESTIGATION OF HYDROCYANIC-ACID GAS FUMIGATION IN CALIFORNIA.

This investigation was begun with the fiscal year. A thorough study was made of the existing methods, and this was followed by the institution of large-scale experiments, covering as rapidly as practicable the different features of the problem, in order to discover the best formulæ and mechanical methods and the particular dosage for the different insects involved and for trees at different conditions as to the effects on blooming or the maturity of the fruit. Many interesting problems have been evolved in this investigation, and the results already achieved have been of great value not only to the citrus-fruit growers of California but to all fruit growers who may in the future have occasion to use this process.

INSECTS INJURIOUS TO STORED PRODUCTS.

An important investigation was begun during the fiscal year concerning the insects injurious to stored cereals in the mills of the South, at the request of many milling companies in Kansas, Oklahoma, Missouri, and Texas, and on behalf of the steamship owners and operators of Galveston, Tex., and New Orleans, La. One of the special subjects has been the flour beetles which injure prepared cereals, especially such as are manufactured in Kansas and Missouri and shipped through New Orleans for European ports. The underwriters who insure against this damage claim that flour shipped southward in the warmer months through the warm climate of the Gulf ports is much more liable to damage by these insects, and report that many thousands of sacks of flour shipped by that route to various European ports within the last year were seriously damaged. In the course of this investigation it has been and will continue to be the especial aim to discover the main points of original infestation—whether in the mills, on the railways, on the steamship docks, or on the steamers; and these points once determined, remedial experimental measures will be instituted.

WHITE FLY INVESTIGATIONS.

The investigation of the white fly in Florida has been continued, on an enlarged scale, under increased appropriations provided by Congress. The important work has been carried on at headquarters, at Orlando, Fla. The principal lines to which the investigation has been devoted during the year were, first, the control of the pest by fungous parasites of the white fly, and, second, control by fumigation. Many important and interesting facts have been determined concerning the fungous parasites, and the fumigation experiments have indicated a favorable outlook for the complete success of the process. An improved tent and a new form of dosage table have been devised, and the process has been simplified so that an orange grower, by following simple instructions, can fumigate his trees with the same degree of accuracy as the most experienced expert. Practical demonstrations have been carried on in St. John, Orange, Hillsboro, Manatee, and Lee counties, and great interest has been manifested by the citrus growers throughout the State.

INSECTS WHICH CARRY DISEASE TO MAN AND DOMESTIC ANIMALS.

Presumably owing in part to the very general spread of information contained in circulars issued by the Bureau of Entomology, the country has been aroused during the last fiscal year as never before to the danger of permitting house flies to breed unchecked and to carry filth and disease through communities. Many boards of health have taken up the matter and much work has been done to emphasize the importance of this insect as a disease bearer. During the year an especial effort has been made to learn exact facts relating to the seasonal prevalence of the house fly, with the idea of comparing, at the close of the season, the increase and decrease of the house fly with the increase and decrease of typhoid fever, in the hope of emphasizing the part played by the house fly in the carriage of typhoid. This work has been carried on in the city of Washington, and the results will be announced upon the completion of the computations.

Three investigators have been at work during the fiscal year upon the facts relating to the life history of the cattle tick. As a result of this study it has become possible to lay down an important law regarding time and conditions when cattle may be allowed to run in pastures without becoming infested. This discovery is based upon the fact that the tick eggs do not hatch in the spring until a certain amount of temperature is accumulated. One of the great difficulties in the control of the tick is that many ranchers are overstocked and can not leave part of their holdings of cattle in certain fields for the time requisite to starve out the ticks. This difficulty is minimized as a result of the discovery above mentioned, since it has shown the latest date on which it will be safe for cattle to remain in pastures from which the ticks are to be eradicated or reduced in numbers. During the year internal parasites of two genera of ticks have been found, and experiments are under way in an attempt to cause these parasites to attack the cattle tick.

BEE CULTURE.

The work on bee culture has been enlarged, and its operations have been unusually productive. The work on bee diseases has been continued through the year, and it has been shown that the annual loss from these diseases, conservatively estimated at $2,000,000, may be considerably reduced by the application of better methods of manipulation. Testing of different races of bees has been carried on near Washington, and a study of the production and care of extracted honey, a study of the present status of bee keeping, experiments on mating queens in confinement, and other work looking toward the bettering of apiculture has been under way.

BUREAU OF BIOLOGICAL SURVEY.

The several lines of investigation under way in the Bureau of Biological Survey at the time of presentation of my last report have been continued and new ones have been undertaken.

RELATION OF MAMMALS TO AGRICULTURE.

In their relations to agriculture mammals differ considerably from birds. Few birds are so harmful that their wholesale destruction is called for, since by devouring destructive insects most of them render a full equivalent for any mischief they may commit. Such is by no means true of mammals. A few are very beneficial, and the usefulness of such servants of man as bats, skunks, weasels, badgers, foxes, and moles should be known and appreciated, that their lives may be spared and they be allowed to continue their good work. Unfortunately, a much greater number of our mammals are everywhere injurious, and are the more dangerous because where they do not exist in great numbers their destructive habits often escape particular notice.

As the result of much experimental field work, the destruction of wolves and coyotes by locating the breeding dens and killing the young and by approved methods of poisoning and trapping have been earnestly advocated as the most practicable means of checking the increase of these formidable carnivores. Circulars describing these methods have been widely distributed to stockmen and others throughout the wolf country, with the result that during the past year more wolves and coyotes were destroyed than ever before, the total number of wolves known to have been killed being over 1,800 and the number of coyotes about 24,000. The saving of stock by this means is estimated at not less than $2,000,000.

Although losses by field mice have proved a steady drain on the resources of American farmers and nurserymen, yet only occasionally and over limited areas has the damage been so great as to attract special attention. The extent of the destruction of crops by mice in the United States has never even approached that in Europe, where they have overrun whole provinces, leaving ruin in their wake. During the past year, however, a native species infested the alfalfa fields in Humboldt Valley, Nevada, in such multitudes as to destroy nearly the whole crop. Out of the 20,000 acres of alfalfa in the valley, 15,000 acres were a total loss, so that the fields had to be replowed and reseeded. During the past year the Biological Survey sent two assistants to Nevada for the purpose of conducting experiments and demonstrating to the ranchmen the best methods of destroying the animals. As the result of trials with various poisons, it was found that sulphate of strychnine on chopped green alfalfa, or when that is not procurable, on alfalfa hay, is a most effective poison. Even on ranches where the number of field mice reached the astonishing total of 12,000 to the acre, relief was obtainable by careful and systematic poisoning at the cost of only 70 cents per acre. By means of the combined efforts of the farmers of the valley, using methods devised by the Survey, the number of mice was finally so greatly reduced that the hawks and owls, gulls, herons, ravens, skunks, badgers, weasels, foxes, and coyotes, which had assembled early in the outbreak and killed at least 45,000 mice a day, were able to take care of the remainder and prevent them from doing serious damage, thus furnishing an important object lesson as to the usefulness of these destroyers of rodents when permitted to do the work they are fitted by nature to perform.

The rat continues to cause great losses throughout the United States. During the past year an attempt was made to ascertain the approximate damage done to property by this rodent in the cities of Washington and Baltimore. Many business men were interviewed, including dealers in various kinds of merchandise, feeders of horses, managers of hotels and restaurants, and manufacturers. The inquiries included all sections of the two cities and both small and large dealers. Data were obtained from some 600 firms and individuals, from which it was estimated that the annual loss from rats in Washington is about $400,000; in Baltimore, upward of $700,000. Assuming, as is probable, that similar conditions obtain in all our cities of over 100,000 inhabitants, the damage by rats in these centers of population entails a direct loss of $20,000,000 annually. This enormous sum gives an idea of the still greater total loss inflicted by this rodent throughout the length and breadth of the land.

The rat continues also to excite grave apprehension because of its agency in distributing the dreaded plague and other diseases. Boards of health and the Marine-Hospital Service in several of our maritime cities have been prosecuting active war against the rodents, and large sums have been expended in efforts to effect their extirpation. No one method has proved adequate, and only by concerted, systematic, and persistent efforts is it possible to reduce and keep down their numbers. The rat-proof construction of buildings, the constant use of traps, and the use of poisons wherever possible will go far toward assuring public safety. Experiments with various poisons and mechanical means of destruction have been made during the year, and a report on the subject with recommendations will soon be issued.

As in previous years, many complaints of damages by rabbits to orchard trees and to various crops have been received. In a previous report the well-known lime and sulphur wash in general use as a remedy against the San José scale was recommended as a protection against rabbits. A number of orchardists have been requested to give this simple and inexpensive remedy a fair trial. It is being experimented with in different sections, and highly satisfactory reports as to its efficiency have been received; hence its use on a larger scale will be urged. If, as has proved to be the case in several instances, a single application of this inexpensive wash will protect orchard trees against the attacks of rodents for a whole winter, the fact can not be too widely advertised.

In the great region west of the Mississippi River ground squirrels are abundant, and in States where grain is extensively cultivated they are exceedingly destructive and annually cause the loss of many thousands of dollars. In California it has lately been discovered that their presence in a community threatens a danger far greater than any pecuniary loss, however large. Recent investigations conducted by the United States Marine-Hospital Service prove that at least one species of ground squirrel is susceptible of plague, and carries the germ of this dread disease, which, as in the case of rats, is communicated to human beings through the agency of fleas.

A bulletin on the subject, containing directions for destroying the animals and accompanied by a map showing definitely the area infested by the Beechy ground squirrel, is in course of preparation and will be widely distributed among farmers and others, especially in the coast districts, where the danger of the infection of squirrels by plague-stricken rats is greatest.

DEER FARMING.

For the purpose of raising deer for the market their domestication, even their semidomestication, though feasible enough, is not necessary; and one of the greatest advantages of the business is that tracts of unproductive land, when fenced, may be utilized for the purpose, the animals remaining almost in their natural state. It is claimed that there are 250,000,000 acres of land in the United States unfit for general agriculture or for the pasturage of horses, cattle, or sheep, upon which the raising of Angora goats would be profitable. It is thought that a large part of this vast tract, with equal or greater advantage, could be devoted to the growing of venison. The greatest obstacles at present in the way of the successful prosecution of the business of deer farming are State game laws. A Farmers' Bulletin on deer farming has been issued, detailing the results of past experiments, setting forth future possibilities, and explaining the best methods of procedure.

FOX FARMING.

Fox raising has already been undertaken by a number of persons with more or less success, according to the location, amount of capital invested, and experience. As the result of recent investigations in the field, supplemented by correspondence, much information on the subject has been obtained, and a Farmers' Bulletin containing the essential details of the business has been issued and is now being distributed. It is believed that in regions suited to the business fox farming may be undertaken by farmers and others with excellent promise of success and that it will yield satisfactory returns for the investment of the necessary capital, time, and labor.

RELATION OF BIRDS TO FRUIT RAISING.

An accurate knowledge of the relations of birds to the orchard is peculiarly important that the orchardist may know his friends from his enemies, especially since among the birds that seem to be enemies are some whose services in destroying noxious insects more than compensate for the toll they levy on the fruit. Much attention has been paid to this subject in its relation to the west coast, where the industry of fruit raising is each year becoming more and more important, and the stomachs of more than 600 birds, including many of great economic value, have been examined and the contents determined. The work has been pushed as rapidly as possible, and the second and final part of a report on the birds of California in relation to fruit raising is now nearly ready for the press.

GAME PROTECTION AND INTRODUCTION.

The present means by which the Biological Survey controls or influences bird and game protection are: (1) By supervising bird and game reservations; (2) by supervising interstate commerce in game; (3) by supervising the importation of wild birds and mammals from foreign countries; (4) by cooperating with officials, organizations, and individuals concerned in the protection of game and birds, and (5) by furnishing information by means of publications and correspondence concerning the preservation of game and birds.

The operations of the year may be briefly summarized as follows:

Nine new bird reservations, making a total of 16, were created by Executive order—located off the coasts of Florida, Louisiana, Oregon, and Washington. Wardens were appointed for the Oregon and Washington reservations, and one for the Florida reservations (five in all). The large colonies of birds that frequent these island reservations will in future be protected and may be confidently expected to increase rapidly.

The usual careful scrutiny of all consignments of wild birds and mammals imported into the United States was maintained throughout the year. Two mongoose—animals specifically prohibited from entry by the act of May 25, 1900—were refused admission at New York in January, and in February a consignment of song thrushes designed for liberation on Coney Island and 200 skylarks to be liberated in California were also denied entry, owing to the danger of these European birds becoming pests in this country, as they have in Australia and New Zealand. Birds and mammals are entered principally at New York. Of 103 consignments inspected 99 arrived at that port. It may be noted that the total cost of inspection, by means of which this large country is guarded against the danger of the introduction of animal pests, is less than $1,000.

The number of birds imported into the country continues to grow, and this year reached a total of about 450,000, consisting, as usual, mainly of canaries. The importation of eggs of game birds for propagation shows a decided falling off, the total number brought in being only 714. Especial interest attaches to the importation of European partridges for stocking covers. The number brought over was 7,783, an increase of more than 100 per cent over the importations of the previous year. This apparent growth in popularity of the partridge of Europe as a game bird for America is readily explained by the decrease of two of our own important game birds—the bobwhite and ruffed grouse—both of which have recently suffered severely from climatic vicissitudes.

DIVISION OF ACCOUNTS AND DISBURSEMENTS.

To carry on the work of the Department of Agriculture during the fiscal year ended June 30, 1908, Congress appropriated the sum of $13,123,040, an increase of $1,940,300 over the preceding year. Of this appropriation $8,537,290 covered the ordinary expenses of the

Department, $3,000,000 the permanent annual expense for meat inspection, $1,152,000 the agricultural experiment stations, and $433,750 the printing and binding done under the Public Printer.

The disbursements of the Department for the fiscal year 1908 amounted to $14,148,329.29, and the greater part of the balance of $668,462.34 will be required for the settlement of outstanding liabilities. The apparent excess of disbursements over the appropriations for this fiscal year is due to unexpended balances, amounting to $1,693,751.63, brought forward from "Administration, etc., Forest Reserves," and other special appropriations.

The amount paid for rent of buildings in the District of Columbia for the several branches of the Department was $65,705.

All accounts for the fiscal year 1906 having been settled, the unexpended balance of appropriations for that year, amounting to $196,619.10, was covered into the Treasury on June 30, 1908. The account for the fiscal year 1907 is still open.

The amount estimated for the fiscal year 1910 in the regular appropriation bill is $14,610,626, which includes $720,000 for agricultural experiment stations. In addition there will be a permanent appropriation of $3,000,000 for meat inspection, a permanent appropriation of $624,000 for additional allotments to agricultural experiment stations under the Adams Act, and $510,000 for printing and binding to be done under the Public Printer, making a grand total of $18,744,626, which is an increase over the fiscal year 1909 of $3,084,520, or 19.7 per cent. Of this increase $2,095,300 is for maintenance and improvements of the National Forests, and the balance, $989,220, is distributed among the other Bureaus and Divisions of the Department.

To sum up the fiscal affairs, it may be added that the principal items of increase each year are for the maintenance and improvement of the National Forests and for carrying into effect the provisions of the food and drugs act. In connection with the expenditures for National Forests, the offset of revenues from the sales of timber and grazing should be taken into consideration. During the fiscal year ended June 30, 1908, these amounted to $1,839,374.92. Since July 1, 1907, these revenues have been deposited in the Treasury to miscellaneous receipts, while prior to that time they were used for the maintenance and improvement of the National Forests, so it will be seen that the National Forests are practically self-supporting.

At the present time the total area of our National Forests is 167,027,319 acres, and the estimated cost of maintenance 2.73 cents per acre, a very small amount when compared with the cost of maintaining forests abroad. France expends annually upon her state forests 95 cents per acre, Switzerland $1.32, Prussia $1.58, and Saxony $2.32. These countries are named because in them the management of the forests is most profitable in products.

DIVISION OF PUBLICATIONS.

During the past fiscal year 1,522 publications were issued, containing 58,510 printed pages. Of these, 477 were new publications, 998 were reprints, and 77 were publications of the Weather Bureau. The total number of copies of all publications printed during the year was 16,875,516. These figures represent but a slight increase over the corresponding figures for 1907. There was, in fact, an actual decrease of 74—or about 14 per cent—in the number of new publications, the increase being entirely in reprints to meet the demands for copies of publications already issued.

DISTRIBUTION OF FARMERS' BULLETINS.

It is the Department's established policy to make the widest possible free distribution of Farmers' Bulletins, written in simple, popular style and printed in cheap form. During the past year 26 new bulletins were added to the list, bringing the total number in the series up to 327. Of these new bulletins more than three-quarters of a million copies were issued, and the reprints of earlier bulletins, for which there is a strong and steady demand, made the grand total of Farmers' Bulletins issued considerably above 6,000,000 copies. Usually four-fifths of the copies printed are allotted to Senators, Representatives, and Delegates for distribution among their constituents. It has invariably happened that some Members of Congress called for only a part of their quotas, leaving the remainder in the document and folding room of the Department. To prevent the accumulation of these unused residues and at the same time to enable the Secretary to place these bulletins where they would serve their intended purpose, Congress, prior to the year 1907, uniformly provided that these unused residues of Congressional quotas should revert to the Secretary for distribution after a fixed date. Under this provision the Secretary was able each year largely to supplement the insufficient supply of Farmers' Bulletins allotted to him.

SALE OF DEPARTMENT PUBLICATIONS.

The year's records of sales of Department publications by the Superintendent of Documents again demonstrated the great popularity of the reports and bulletins of this Department, and the wisdom of providing for their sale and the use of the proceeds in printing additional copies. During the year the Superintendent of Documents sold 94.626 copies of different publications of this Department and received therefor $14,174. The number of copies sold was nearly three times as great as in 1904, and 23,000 more than in 1907. The sales of this Department's publications also exceeded those of all the other Departments combined by about 33,000 copies.

BUREAU OF STATISTICS.

INTERNATIONAL INSTITUTE OF AGRICULTURE.

The International Institute of Agriculture, established under the patronage and through the efforts of the King of Italy in 1905, will be practically organized in the winter of 1908–9. This institute is sustained by forty-six countries, and the membership of the United States is established by the treaty of January 29, 1908.

Among the purposes of this institute are the collection, study, and publication of statistical, technical, and economic information concerning farming, both vegetable and animal products, the commerce in such products, and the prices prevailing in the various markets; the ascertainment of the wages paid for farm labor; the publication of information concerning new diseases of vegetables which may appear in any part of the world; the publication of information concerning agricultural cooperation, insurance, and credit; and the submission to the adhering governments of measures for the protection of the common interests of farmers and for the improvement of their condition.

INVESTIGATIONS OF PRODUCTION AND DISTRIBUTION.

The organization of the Bureau of Statistics has undergone a change so far as it relates to the division formerly known as "Foreign Markets," the work of which has become larger in scope. This division is now concerned with Investigations of Production and Distribution. It studies the production of wealth on farms, the distribution of farm products at home and abroad, and the economic conditions pertaining to the agricultural element of the population.

PUBLICATIONS AND LIBRARY.

The branch of the Bureau formerly known as the Miscellaneous Division has also been reorganized, and has been named the Editorial Division and Library. This reorganization was made necessary by a notable increase in the number of publications issued from the Bureau; a constant increase in the number of requests, from all classes of the public, for statistical information; and continuous accessions to the Bureau's library of foreign, Federal, State, and municipal statistical literature.

CROP REPORTS ISSUED ON EARLIER DATES.

The monthly crop reports during the year have been published earlier and nearer the dates to which they relate. The reports as to cotton relate to the 25th of the month, and were formerly published on the 3d of the following month; this year their publication on the 1st or 2d has been secured, and it is believed that the date of publication may hereafter be made not later than the 1st of each month. The reports as to grain and other products relate to the 1st of each month, and have been formerly published on the 10th. This year their publication has been made on the 8th or 9th, and it is expected to secure their publication not later than the 7th or 8th of each month.

CROP REPORTING BOARD.

The plan of intrusting the final preparation of reports to a Crop Reporting Board has been continued, and after three full years of trial it has been demonstrated to be an excellent and satisfactory method. It avoids placing all the strain and responsibility on one man, and secures the benefits of consultation and a consensus of judgment among men who have been on the ground.

SPECIAL INVESTIGATIONS.

During the past year the Bureau began the collection of information concerning farmers' cooperative organizations, of which there are an immense number in this country, embracing more than half of the farmers. This undertaking will require several years.

A compilation of the statistics of agricultural imports of the United States, beginning with 1851, was completed. A similar compilation for agricultural exports was made five years ago, and recently the statistics of the re-exports of agricultural imports, or the so-called "foreign exports," were compiled for the same period of years, so that the statistics of the entire foreign trade in every agricultural community for more than half a century will soon be made available to the public.

An exhaustive statement of the acreage, production, and foreign trade in tobacco of the American colonies and of the United States from the earliest times to the present year was undertaken and nearly accomplished.

An extensive investigation of the production, trade, and supply of wheat in principal countries was commenced. The plan is to give special attention to conditions in countries which export wheat and to the consumption and markets in the principal importing countries.

A compilation of the statistics of imports of farm products into the Netherlands for the years 1904–1906 was prepared. The quantity of durum wheat exported from the United States in the fiscal year 1907 was ascertained from reports received from correspondents at the leading grain markets and seaports. What is substantially the world's production of wool was ascertained with much difficulty for inclusion in the agricultural statistics of the Yearbook of 1907. This is the first publication of this information by the Department.

The Bureau is bringing to completion a plan by which it is hoped to secure statistics of tobacco production by types. The State is the smallest unit or geographical division for which the Bureau at present issues detailed reports comparable with similar reports on other products which have been prepared for a long series of years. By the proposed method there can be secured statistics of the amount of each of the different types of tobacco grown in the States where more than one type of tobacco is grown.

DEPARTMENT LIBRARY.

The Library has been moved into the basement of the east wing of the new Department building, where it is commodiously housed in 18 rooms, originally designed for laboratory uses. It is of interest to note that at the time of moving the Library contained 100,000 books and pamphlets, whereas when it was first established in the old building in 1868 it contained less than 1,000 volumes. It is also matter for congratulation that this collection of books of such great value to the agricultural interests of the country is now stored in a fireproof building. In the work of preparing catalogue and index cards, and in all other usual lines of work, the Library has had a very successful year.

OFFICE OF EXPERIMENT STATIONS.

RELATIONS WITH THE AGRICULTURAL EXPERIMENT STATIONS.

Twenty years have passed since the Office of Experiment Stations was established to act as a general agency for the promotion of the interests of the agricultural experiment stations, which were then being organized on a National basis in accordance with the provisions of the Hatch Act. Although at the outset that Office had no authority over either the work or the funds of the stations, and even now exercises only a very limited control, it has nevertheless been an important factor in promoting their growth and development.

Its relations with the stations have never been more cordial than they are at present, and its influence never broader nor more potent. The scrutiny which the Office makes of the stations' work as related to their use of Federal funds is now more extended and painstaking than ever before. Since this is made, however, in a helpful spirit, the stations generally recognize that it is calculated to promote their best interests and stimulate them to more thorough work for the benefit of American agriculture.

The stations have developed a vast fund of practical information, much of it resting upon a scientific foundation, and have developed their special methods of work. But the dissemination of this information and its demonstration to the farmer have, to some extent, called for a special corps of workers. The supply of competent men to carry on experiments and investigations has never fully equaled the demand, and hence the pressure for their investigations has fixed distinct limits to the time which they could spend in the extension of their work to the farmer. The demand for assistance of a direct nature and the need of various forms of instruction and demonstration have increased year by year. As a result of this condition there has been a sharper differentiation of duties, and the working staff of the station has been relieved, to a large extent, from other forms of activity. Special workers have been provided to look after the teaching work of the college and to do much of the demonstration work and local experimenting, leaving the investigators more largely to their special duties. This broader organization has increased the efficiency of each branch of the work.

The stations are doing more scientific work and at the same time a large amount of practical work. They are carrying their studies more thoroughly over the State and in this way reaching a larger proportion of the farmers and a larger proportion of their problems. The scientific researches inaugurated by the stations under the Adams Act are already pointing, in many instances, to ultimate practical results of fully as great value as those derived from much of the more superficial work and are laying the foundations of the industry broad and deep.

It has been decisively demonstrated that the granting of Federal aid to the States for the maintenance of the stations gave an immediate and tremendous impulse to the organization of these institutions throughout the country and led to increasing liberality on the part of the States in providing for their equipment and maintenance. The latest statistics of the stations gathered by the Office of Experiment Stations show that though the Federal aid to them was greatly augmented by the passage of the Adams Act, the increase in their local funds kept pace with this, so that now more than half the annual income of the stations is derived from sources within the States.

Four hundred and eighty-four station officers do more or less teaching in the colleges with which the stations are connected. During the year the stations published 459 annual reports, bulletins, and circulars, which were supplied to over 774,000 addresses on the regular mailing lists. A larger number of stations than formerly supplemented their regular publications with more or less frequent issues of press bulletins and other special publications, and most of the stations report a large and constantly increasing correspondence with farmers on a wide variety of topics.

THE AGRICULTURAL COLLEGES AND SCHOOLS.

The progress made in agricultural education in the United States during the past eleven years as a result of popular demand stimulated by the work of the State agricultural colleges and experiment stations and of this Department is unprecedented in the history of the world. In 1897, when the present administration of this Department began, all but one of the land-grant colleges were in running order and doing excellent work, but their total income was only $5,000,000; to-day it is almost $15,000,000. The property of these institutions was then valued at $51,000,000; now at $96,000,000. Then there were less than 4,000 students in agricultural courses; now there are over 10,000. Ninety of the 1907 graduates of these courses accepted positions in the agricultural colleges and experiment stations or in this Department at salaries ranging from $500 to $1,700 and averaging $948.66. It is stated by presidents of the agricultural and mechanical colleges that of late the graduates of agricultural courses find remunerative employment much more readily than the graduates from engineering courses.

But the most rapid progress has been made in the field of secondary and elementary education in agriculture. In 1897 Minnesota had the only State agricultural high school and Alabama had just made provision for the last of its nine district agricultural schools. The teaching of agriculture in the public elementary schools was scarcely thought of. To-day there are 15 agricultural high schools of the Minnesota type and 40 other agricultural high schools receiving State aid, 16 privately endowed colleges and high schools giving instruction in agriculture, 115 State and county normal schools preparing young people to teach agriculture, and, on our lists, over 250 public and private high schools and academies giving some instruction in agriculture. There are 16 institutions offering correspondence and reading courses in agriculture and 26 private or special elementary agricultural schools.

In thirteen States the teaching of agriculture in the rural schools is now required by law. It is encouraged by State and county school officers and taught in some of the rural schools of thirty-one other States and Territories. Forty-four States and outlying possessions, then, are making some effort to teach their youth the underlying principles of our greatest productive industry.

This Department is aiding in the promotion of this great movement through all its different Bureaus and Divisions, but the Office of Experiment Stations is giving special attention to it. That Office is cooperating with the Association of American Agricultural Colleges and Experiment Stations, with the National Education Association and other educational associations and their standing committees, and with State and local school officers in the different States and Territories in preparing suggestive courses of study in agriculture, horticulture, and other related subjects, in developing suitable laboratory material and exercises for schools of different grade, and in securing suitable literature to supplement the agricultural text-books and manuals used in the colleges and schools. Many of the publications of this Department are used in this way.

Congress has granted a small additional appropriation for the work of the Office of Experiment Stations in relation to agricultural colleges and schools, which will enable the Office to increase the effectiveness of its organization to some extent, but not in proportion to the rapidly increasing demands made upon it by educational institutions throughout the country. It will not be possible to branch out along new lines, but it is hoped that with the aid and cooperation of other Bureaus of the Department, a beginning may be made in the preparation of two new classes of publications now much needed for the assistance of teachers and pupils in public schools: (1) Instructional publications or brief monographs giving reliable and up-to-date methods of performing certain agricultural operations, such as How to restore humus to the soil, How to prevent soil erosion, How to manage the wood lot, How to get a good stand of corn, How to make and apply Bordeaux mixture, etc., and (2) informational publications, brief monographs concerning the origin, distribution, and importance of leading agricultural crops, and the supply, distribution, and importance of our National agricultural resources. Publications of the first class are needed mainly by the schools in which agriculture is taught, but those of the second class, informational publications, are in demand from all classes of schools, city and rural, to supplement the text-books of geography, botany, zoology, and agriculture.

FARMERS' INSTITUTES.

The farmers' institute has developed until it has become a leading agency in the dissemination of agricultural information. Over 2,000,000 people are reported as having attended the regular institute meetings during the year and 164,000 the special institutes, while there was furnished by State and local authorities $318,000 for carrying on the work. The appropriations represent an increase of $44,000 and the attendance an increase of 415,000 over the previous year.

INSULAR STATIONS.

The efforts of the Alaska, Hawaii, and Porto Rico stations along the lines of diversified agriculture have been continued. The Alaska stations devote their principal efforts to live stock, horticultural crops, and cereal growing. The cattle formerly at the Kenai station have been removed to Kodiak and the two herds combined. The station now has about 60 head of registered Galloway cattle, which have demonstrated their ability to withstand winter conditions by going through the last winter without any shelter except an open feeding shed. A larger range is needed for the animal-breeding station, and a survey has been made of a suitable tract. The horticultural investigations at Sitka are quite promising. In the young orchard some of the trees have shown their first blooms, and a few varieties of cherries bore fruit this year. The plant-breeding work is being continued, and as but few varieties of apples have so far shown any indication of surviving Alaskan winters, experiments are being conducted in pollinating some of the most promising varieties with pollen from the native crab apple, and seedlings will be produced as fast as possible.

During the past season some of the crosses between the wild and cultivated strawberry and the hybrids between the salmon berry and the cultivated raspberry bore fruit, and selection experiments will be conducted for the establishment of any desirable varieties. A species of willow which is well adapted to basketry has been introduced by the station and was found to grow exceedingly well. The cereal investigations are carried on principally at Rampart and Copper Center, where selections of the earliest ripening heads of every variety are being made. A severe frost again destroyed the grain crop at Copper Center, but at Rampart all varieties yielded well, as has been the case nearly every year since the establishment of the station in 1900. Work was actually begun in developing a station near Fairbanks, reserved for that purpose by executive order, March 22, 1906. About 10 acres were planted to oats and potatoes and arrangements made for clearing more land and for the erection of much-needed buildings. At the Copper Center station plant breeding with native grasses and leguminous plants has been begun, and about 90 species have been brought together for further study.

The Hawaii station continues its work in the diversification of agriculture in those islands. The experiments in shipping tropical fruits have been continued, and it has been demonstrated that pineapples, avocados, and similar fruits may be successfully shipped to any point within thirty days' direct communication with Honolulu. The rice investigations have been continued and extended, and the value of sulphate of ammonia and other high-grade fertilizers when applied to rice has been shown. The results of these experiments have already become well known, and dealers in fertilizers report a marked increase in the sales of high-grade fertilizers to rice growers. The studies in Hawaiian honey made by the entomologist have resulted in the adoption of suggestions whereby a largely increased revenue is obtained by bee keepers. A study has been begun of the insects affecting live stock and suggestions made for the control of some of the more troublesome ones. Among the more promising of the newly developed agricultural industries of Hawaii is pineapple growing, and the study of the soil and fertilizer requirements of this crop has been begun on a comprehensive scale. All the departments of the station will give attention to the problems connected with the cultivation and marketing of this fruit. The introduction of Chinese and Japanese matting rushes has been successfully made and the profitableness of growing these seems to be well established. An experiment in harvesting salt-marsh rice for hay has indicated that large quantities of such hay can be produced in Hawaii to take the place of the hay which is imported, to the amount of $350,000 worth annually, most of it coming from California. The experiments in tapping rubber trees have been continued, and, as showing the possibilities of rubber production, two Ceara rubber trees which had been tapped in July, 1907, when tapped again in January, 1908, yielded 6½ ounces of dry rubber in nine days. When it is considered that more than 600,000 rubber trees, 90 per cent of which are Ceara rubber, have been planted in Hawaii within the past three years, the importance of experiments in tapping and with coagulants for rubber latex may be appreciated.

The work in Porto Rico consists of experiments in plant and animal introduction and breeding, crop production, control of insect and fungus pests, reforestation, etc. Seedling pineapples and seedling sugar canes, some of which were originated at the station, and improved varieties of other important crops are under observation at the station. Experiments in breeding pigs and poultry have proved quite successful at the station and the surplus is sold to planters at fair prices. No difficulties have been met with in raising any of the improved strains and the demand is always in excess of the station's supply. Experiments in ensiling cane tops for feeding to cattle have indicated the practicability of using this extensive source of forage, most of which is now wasted. Experiments on the reforestation of denuded hilltops are being continued and some varieties of eucalyptus have been found that are well adapted to this purpose. Some of the introduced varieties of coffee are beginning to bear and it is now possible to pass judgment on their qualities. The common Porto Rican coffee has not met with a favorable reception in the continental portions of the United States, and it is believed to be a good policy to introduce the types of coffee which are demanded by the trade. The highly flavored Java coffees seem to retain their well-known characteristics when grown under Porto Rican conditions and coffee planters are taking a deep interest in this experiment and are planting the improved varieties as fast as seedlings can be supplied. The station's suggestions regarding planting, cultivation, pruning, etc., are being quite generally followed on the new plantations. The entomologist has been studying the life history of a number of troublesome insects and has worked out methods for the control of some of them. Parasites of the eggs of the tobacco hornworm, mentioned in the previous report, have been distributed in Porto Rico and also in sections of the mainland. A system of cooperative demonstration experiments has been successfully inaugurated which has proved very popular as a means for the dissemination of information relating to a more rational system of agricultural practice.

Preliminary steps have been taken for the establishment and maintenance of an experiment station in the island of Guam, and the conditions in that island are believed to be favorable for the restoration of agriculture and its development along more modern lines.

NUTRITION INVESTIGATIONS.

According to authority granted by Congress the reconstruction of the respiration calorimeter is proceeding, and reports on investigations made previously are being prepared for publication.

It is expected to take advantage of new features suggested by the work of others or devised by our experts to simplify and improve the respiration calorimeter in several important ways. The work is being rapidly pushed and the apparatus will be ready for use before the end of the fiscal year.

With the aid of the respiration calorimeter it is proposed to study the relative ease of digestion of cheese made and cured in different ways, a line of work of the utmost importance in view of the experiments already completed, which have demonstrated the thoroughness of digestion and high nutritive value of cheese as an economical article of diet. It is also proposed to study with the respiration calorimeter the relative value of butter, lard, beef fat, olive oil, and other edible and culinary fats as sources of energy in the body, a matter on which data are much needed in considering problems now before the Department, and to make similar studies needed to round out the Department's work on the food value of cereal products and meat and meat products.

IRRIGATION INVESTIGATIONS.

As in the past year, the most pressing needs of the arid regions are practical information for settlers on the large areas now being brought under ditch, and the checking of losses of water in its transportation to the place of use and in its application to fields. In view of this fact work has been concentrated on these two lines. Never before in our history has there been so great activity in the construction of canals and reservoirs to provide a water supply for our arid lands. The construction of these works is under the direction of trained engineers, while the preparation of the land to receive water, which in many cases involves an expense fully as great as for the works which supply the water, is left to the settlers who come almost entirely from sections where irrigation is not practiced and are consequently ignorant of irrigation practice. Realizing that the proper use of water is fully as important as the proper construction of works, we have made a special effort to make available for settlers in the arid region the same degree of expert knowledge regarding the performance of all the operations connected with irrigation that has been used in the construction of irrigation works. This is being accomplished by studying the practice of the older irrigated sections to get the benefits of their experience, and by experiments to get a more exact knowledge of the action of water in the soil and the effect of different methods of applying water and cultivating the soil. To make the results of this work available as soon as possible, many special agents have been employed to assist our regular force of experts. It is estimated that there is now under ditch and awaiting settlement fully 5,000,000 acres. To cultivate these lands will require 100,000 settlers. It is also estimated that each settler must invest at least $1,500 in cash in addition to his labor in establishing himself on a new irrigated farm, calling for an expenditure of $150,000,000, a very large part of which will be wasted if settlers are not given expert advice.

The magnitude of the losses of water in irrigation practice and the importance of checking these losses have been repeatedly mentioned in former reports. Careful observations indicate that not to exceed one-third of the water diverted from streams or stored in reservoirs is actually used by crops in the processes of growth. As the area which can be irrigated is limited by the water supply, not by the extent of available land, any preventable loss is an unnecessary restriction of the irrigated area. Some loss is unavoidable, some can be prevented only at great expense, but much can be done by a better adaptation of methods to the conditions of soil and subsoil without any noticeable increase in present cost. In no other way can so great an additional area be supplied with water at so small an expense. This saving, however, requires an accurate knowledge of the action of water on the soils of different types, and to secure this we are carrying on both tank and field experiments throughout the arid region.

Settlement of the semiarid region by those who expect to engage in dry farming has continued with little check, but the experience of these settlers has increased the demand for information regarding the possibilities of developing small water supplies for the irrigation of limited areas in connection with the farming of large areas without irrigation. The farms established for securing such information and for demonstrating the methods of use and the advantages of irrigation have been maintained during the past year and should be continued. The water for the dry farms on the plains must be pumped from underground sources or stored from storm waters.

DRAINAGE INVESTIGATIONS.

Recent estimates made by the Department place the total area of unreclaimed wet lands in round numbers at 79,000,000 acres. With reference to their productive value as affected by their natural wet condition, these vast areas may be classified as follows:

(1) Lands which are permanently wet and are never fit for cultivation even during the most favorable years.

(2) Lands which afford pasturage for live stock, though the forage which they produce may be of indifferent quality.

(3) Lands which in their natural condition are subject to periodical overflow by streams, but which at other times produce valuable crops.

(4) Lands which yield profitable crops during seasons of light or medium rainfall, but which are wholly unproductive in seasons characterized by greater than the normal rainfall.

It is estimated that of the first class there are 52,000,000 acres; of the second class, 7,000,000 acres; of the third class, 15,000,000 acres, and of the fourth class, 5,000,000 acres. In addition to this area it is estimated that there are 150,000,000 acres of occupied farm land whose production would be increased 20 per cent, without additional labor in management or cultivation, were it judiciously drained.

The existence of these conditions suggest that immense agricultural possibilities lie before us in the reclamation of the so-called swamp lands, and also in the better drainage of lands which are now under cultivation. That marked attention is being given to this subject by landowners is evinced by the large number of inquiries received by the Department upon matters directly related to agricultural drainage.

OFFICE OF PUBLIC ROADS.

RELATION OF ROADS TO AGRICULTURE.

For many years the Department has endeavored to impress upon producers and consumers the close and intimate relationship of the public road to agriculture, and while endeavoring by practical demonstration and scientific experiment to improve methods of construction and maintenance, has lost no opportunity of awakening the public to a proper appreciation of the great economic importance of road improvement and the necessity for reform in the management of the public roads. Some conception may be had of the immensity of the task by considering the fact that there are 2,151,000 miles of road in the United States, a sufficient length to encircle the globe at the equator with 86 parallel roads. The total expenditure upon roads for

1904 was nearly $80,000,000. At that time about 38,600 miles had been surfaced with stone, 108,200 with gravel, and 6,800 with special materials, making the whole mileage of improved roads only 7.14 per cent of the total. An effort has been made by the engineers of this Department to estimate the mileage of improved roads in 1908, and the total value of all roads, including bridges and rights of way. Taking the 1904 figures as a basis, and assuming that the macadam roads have increased 12.5 per cent, the gravel 15 per cent, and those surfaced with special materials 25 per cent, we have 43,450 miles of macadam, 124,468 of gravel, and 8,512 surfaced with special materials. The cost of the macadam has been estimated at $4,500 per mile, of the gravel at $1,500, and of other surfacing materials at $1,000.

There are about 1,975,000 miles of earth road, which it is estimated have cost for grading, culverts, bridges, and all other items of expense an average of $500 per mile. The right of way, which has been estimated at 40 feet in width for the entire mileage, is worth at the average acreage valuation as given in census reports $342,000,000, making a total estimated cost of $1,720,339,000 for all the roads of this country. Over these roads at least 250,000,000 tons of freight are hauled every year to railroads, not including the immense tonnage hauled to wharves and docks for water shipment, which we are unable to estimate. The data collected by the Department indicate that this hauling is done at an average cost of not less than 23 cents per ton per mile, and that the average haul is about 9 miles, which goes to show that the transportation over the public roads to the railroads represents an annual cost of over half a billion dollars. Hauling in France is done in many cases at as low a cost as 7 cents per ton per mile, and the average there is probably not more than half of the average for the United States. The selling price of farm products is largely determined by factors beyond the control of the farmer. His prosperity must be measured by the margin of profit above the cost of production and of transportation; and it is only when the great agricultural population awakens to a realization that the road problem is a farm problem that we can look for substantial progress in this important branch of transportation.

HIGHWAY ENGINEERING.

The Department has for several years successfully carried out a plan of appointing each year a small number of graduates in civil engineering and giving them thorough and practical training in highway work for a period of one year. This is not gratuitous instruction on the part of the Government, as the young men, while receiving a small salary and valuable instruction, are, on the other hand, rendering service to the Government. At the end of one year these students may be retained in the service without further examination and promoted to the position of assistant engineer. The plan has worked out exceedingly well, and a number of young engineers have passed from the Government service to important positions in State and county road work.

SAND-CLAY ROADS.

In many sections of country, almost entirely without road-building rocks, the cost of macadam roads is prohibitive. Sparse population and lack of funds prevent the building of hard roads in many cases. To meet the needs of such localities, the Department has by research and experiment endeavored to devise methods of construction which would utilize to the best advantage the materials immediately available. For many years the sand-clay method has been in successful operation in various Southern States, and the Department has endeavored to bring it more and more into general use. The past summer witnessed the beginning of experiments with the sand-clay method at Englewood, Kans., and later in the summer at Dodge City, Kans. The people at these Kansas points are enthusiastic over the possibilities of the sand-clay road, and at this stage of the work the indications are that the experiment will prove as successful on the Great Plains as in the South. If our hopes are realized in this work, a tremendous benefit will result not only to Kansas, but to many of the trans-Mississippi States.

BURNT-CLAY ROADS.

For several years the Department has been conducting experiments with burnt clay in the Mississippi Delta region. While the experiments have not been uniformly successful, the Department feels justified in announcing that burnt-clay roads are entirely feasible, and under favorable conditions are almost as satisfactory as macadam. A burnt-clay road completed by the Office of Public Roads of this Department at Greenville, Miss., on November 4, 1907, withstood the trying climatic conditions of the winter and spring and an exceedingly heavy traffic, and showed very few signs of damage at the close of the past summer. Another burnt-clay road at Tallulah, La., constructed during the past summer, is now in excellent condition. The burnt-clay road will generally be constructed in sections of country where macadam materials are not available, and in such cases the cost will probably not exceed on the average one-third the cost of the macadam.

DUST PREVENTION.

The destructive effects of automobile traffic on macadam roads have occasioned much uneasiness, as many million dollars have been expended in this form of construction. The engineers of the Department have, in common with others in this country and in France and England, conducted numerous experiments with a view to determining the exact cause of the deterioration of macadam roads and to devising methods of treatment or construction which would effectually meet existing conditions. The materials used in the experiments by the Department have included, among others, tar preparations, asphalt oils, temporary expedients, such as calcium chloride, and several special preparations originated by the Office of Public Roads of this Department. Some measure of success has attended the work thus far, and it is hoped that much progress will be made within the next few years.

OBJECT-LESSON ROADS.

Measured by comparison with previous years' results, the object-lesson work of the past year was the most successful in the history of the Department. At the close of the year 31 object-lesson and experimental roads had been completed, or were in course of construction, illustrating the best methods of road construction as adapted to conditions in each section of the United States. These object-lesson roads were instrumental in the giving of instruction in the art of road building, and it may therefore be said without exaggeration that the Department maintained 31 temporary schools in road building.

The engineers from the office made the necessary surveys and prepared the plans and estimates and supervised the construction, instructing the local road builders at each stage of the work. In all, 10 macadam, 6 sand-clay, 4 gravel, 3 earth, 3 burnt-clay, 1 shell, 2 tarred, and 2 oiled roads were constructed, making a total of 223,208 square yards of road surfaced. Object-lesson and experimental roads were constructed in Massachusetts, Virginia, West Virginia, South Carolina, Kentucky, Tennessee, Georgia, Florida, Alabama, Mississippi, Louisiana, Texas, Wisconsin, Missouri, Arkansas, North Dakota, Nebraska, and California during the year.

UTILIZATION OF BY-PRODUCTS.

Approximately 20,000,000 tons of blast-furnace slag are produced annually in the United States, most of which is a total waste. Slag has been used very slightly as a road-building material, for the reason that it is exceedingly difficult to maintain a well-bonded surface. The Office has, during the past year, inaugurated experiments in the building of roads of slag in combination with tar and asphalt preparations along original lines. It is hoped that these experiments will not only open the way for a more general use of slag as a road material, but that the addition of bituminous binders will result in much progress in the development of dustless roads.

CORROSION OF IRON AND STEEL.

This investigation was begun for the purpose of determining the cause of corrosion of metal road culverts, and to discover if possible the means of preventing or minimizing the corrosion. Investigation thus far has produced data of great scientific and practical value, which are set forth in publications issued by this Department. The results of the work have already proved of great benefit, as several of the rolling mills have materially modified their methods of manufacture to conform to the conditions indicated as essential in the results of the investigations.

During the past summer test fences were erected at Pittsburg and Atlantic City, and at the latter place a number of large plates of steel were set up in frames facing the ocean. These plates were painted with standard pigments and with pigments prepared according to specifications drawn up in the Office of Public Roads. The purpose of this test is to determine the relative merit of the pigments used in the prevention of rust.

REVIEW OF TWELVE YEARS.

In presenting an account of the work of the Department it may be worth while to survey the last twelve years of endeavors, and of their fruition and promise, to which not only this Department has contributed, but also the experiment stations, the agricultural schools and colleges, the State boards and commissioners, the agricultural press, and the farmers themselves in their individual and collective efforts.

Momentous changes have occurred to agriculture in this country during the last dozen years. Features of great import have been introduced. Forces have become operative whose results are already enormous, with the certainty of cumulative and accelerated future consequences for the Nation's good and well-being. The farmer's work and harvest have had the benefit of more varied knowledge and more effective intelligence. His life and living have undergone transformations which increasingly make the farm preferable to the town.

IMPROVED FINANCIAL CONDITIONS.

This period has developed an amazing and unexampled prosperity for the farmer. His improving financial condition has been both an effect and a cause—an effect partly of his own efforts joined to those of public agencies, and also the means of making his life and the lives of his wife and children better worth living.

More wealth has been invested in improving the farm home and in the current expense of farm life. With better houses filled with modern conveniences, the family life has developed in strength and in enjoyable living. Through the introduction of machinery, the betterment of buildings and appliances, and the improvement of methods the farmer's labor is rapidly becoming less in physical stress, and the burdens of the household are becoming lighter. Child life on the farm is entering upon a realm of favoring conditions in the home, at school, and in farming, and home-making apprenticeship is rising to a higher level.

CHANGE FROM LOW TO PROFITABLE PRICES.

The year 1897 or thereabouts marked the farmer's financial turning point. The prices of his products had previously often been below the cost of production, and he occupied a weak position as a seller. Within a very few years thereafter prices had risen so as to make him strong as a seller and to enable him to hold his crops for fair prices.

Corn was worth but 21.5 cents a bushel at the farm December 1, 1896, as an average for the United States, and less than that in the great corn States. By 1900 the price had risen to 35.7 cents, and the November price of this year is 63.5 cents.

Wheat sold for as little as the average of 49.1 cents a bushel December 1, 1894; a marked increase to 69.5 cents favored the crop of 1903, and now the November price is 91.5 cents.

The farmers and planters of the cotton States were in a wretched financial condition when the cotton crop of 1894 was sold for 4.6 cents a pound. Their independence began with the price of 11.66 cents in 1903. During the last six years the mean price of cotton to the growers has been 9.865 cents and the seed has brought them many millions of dollars annually.

Hay was worth at the farm only $6 a ton in 1898; the price rose to $10.01 in 1901, to $11.68 in 1907, and it was $9.22 on November 1 of this year. The farm price of oats was at the low figure of 18.7 cents a bushel in 1896; in 1901 it was 39.9 cents; in November, this year, 46.5 cents. Barley was sold for 32.3 cents in 1896, 45.9 cents in 1902, 66.6 cents in 1907, and 53.7 cents in November, 1908. Rye was at the low price of 40.9 cents a bushel in 1896; in 1901 the price was 55.7 cents; in November, 1908, 73.7 cents.

Tobacco was not worth raising at the average price of 6 cents a pound in 1896; there was some improvement with 8.1 cents in 1904; still more with 10.9 cents in 1907; and perhaps a higher price this year. In 1896 potatoes brought 26.6 cents a bushel to the farmer; the rise was to 76.7 cents in 1901 and to 69.2 cents in November, 1908.

In the meantime the prices of domestic animals had participated in the forward movement. Horses of all ages had the average value of only $31.51 at the farm January 1, 1897. The average was $52.86 in 1901 and $93.41 in 1908. From the low price of $41.66 per mule in 1897, all ages included, the figure rose to $63.97 in 1901 and to $107.76 in 1908.

The farm price of dairy cows has gone from $21.40 in 1892 to $27.45 in 1898, and to $30.67 in 1908; of all other cattle of all ages, from $14.06 in 1895 to $20.92 in 1898, and to $16.89 in 1908.

A remarkable change in price was in that of sheep, from $1.58 in 1895, all ages included, to $2.46 in 1898 and $3.88 in 1908. Hogs had the low price of $4.10 per head January 1, 1897; the average was $5 in 1900, $7.62 in 1907, and $6.05 in 1908.

The consequences of such rises of prices need not be itemized. The old cotton plantation that no lender wanted as a mortgage security is now sought for investment and its owner can borrow without mortgaging. The farmers of the mortgage-ridden Kansas of former days have stuffed the banks of that State full of money, have organized banks of their own, and have sent money to the East to invest.

AGRICULTURAL SCIENCE.

Relieved of the weight of debt and of suffering under unprofitable prices, the farmer felt more responsive than before to the help offered by the Department of Agriculture, the experiment stations, and other sources during the period under review. Thousands of learned investigators worked for him. Thousands more talked to him repeatedly. Thousands of demonstrations taught how to do by doing. Many boys were educated in agriculture. Hundreds of millions of copies of publications were sent broadcast. The story of what was done by Nation, State, and private persons can here be stated only briefly.

PLANT AND ANIMAL BREEDING.

Both the science of breeding plants and animals and practical methods have made remarkable advance. During the past dozen years breeding has passed the unorganized stage and has come under the domain of science. Rapid advances are being made in the study of the laws under which heredity operates. The exceedingly great value of the rare mutating plant or animal which has the power to project its unusual individual values into its progeny and thus produce a valuable new strain has come to be appreciated as the most important source of creative breeding.

The breeding of types of Sea Island cotton immune to various diseases; the securing of types of nitrogen-gathering plants to use in rotation with such kinds of cotton; improvements of the fiber of other kinds of cotton and of its productivity; the marked increase in corn production due to knowledge of the laws governing corn breeding; the establishment of important tobacco industries, such as the growing of the Sumatra wrapper leaf and the Cuban filler through adaptation to proper conditions, and the creation of desired strains by breeding; the securing of a whole series of hardy citrus fruits; improvements in wheat and oats—these are some of the grand achievements of plant breeders.

Hybridization and seed selection in the case of existing crops have been performed scientifically to produce varieties to meet new conditions, to produce larger yields, to resist cold, drought, and disease. With the advent of the cotton boll weevil, the breeding of cottons fitted to escape weevil injury, to produce longer staple and heavier yields, and to resist wilt, root rot, and other diseases, was undertaken with gratifying results. Several entirely new cotton hybrids have been developed which possess great improvement over former varieties. This Department's newly bred, heavy-yielding, long-staple Upland cotton, the Columbia, received a gold medal at the Jamestown Exposition.

Corn-breeding methods have developed varieties whose yield is 15 to 25 per cent above that secured by the best of the former varieties. This Department has introduced from Guatemala for breeding purposes new types of corn adapted for growth in the moist Gulf regions and other varieties for growth in the hot arid regions. The development of quick-maturing, high-yielding dent corn for the northern edge of the corn belt has been accomplished by the experts of the Department.

Seed-corn breeders' associations now exist in most of the States of the corn belt. Seed corn is now largely grown as a special crop. Pure strains are being developed, new varieties originated, and older ones improved.

Good progress has been made in breeding single-germ seed balls, which will greatly reduce the labor and cost of growing sugar beets. High-grade sugar-beet seed, fully equal to the best imported, has been bred in this country.

Among the results of breeding tobacco for quality, uniformity, and yield are the Uncle Sam Sumatra, the Hazlewood Cuban, the Brewer Hybrid, and several other improved types which have been disseminated and which give an increased yield of 50 to 75 per cent of great uniformity and high quality.

The Florida sweet orange has been hybridized with the cold-resistant trifoliate orange and several new strains with greatly increased hardiness have been developed, so that the orange-producing area has been much enlarged. From these hybrids it is expected that citrus fruits of great value will eventually be grown throughout the Southern States.

At the Colorado Experiment Station a cantaloupe has been bred that is resistant to the rust fungus. In South Dakota the third generation of seedlings of the native sand cherry produce fruits 1 inch in diameter and of good quality. Native Dakota plums and sand cherries have been hybridized with other stone fruits from Europe and Asia to combine the hardiness of the native fruits with the size and quality, to some extent at least, of the choice cultivated fruits from abroad. In New Jersey practically all of the important vegetables have been subjected to hybridizing and breeding, and many new varieties with desirable qualities have been produced and disseminated.

Good varieties of wheat have been originated by breeding. The Minnesota station originated numerous varieties, two of which have spread over half a million acres, and yield from 1 to 3 bushels more per acre than the varieties formerly grown. The Maryland and Michigan stations bred new varieties of wheat, which are now grown in those States. The winter-wheat belt has been extended farther and farther north by sowing adapted varieties until it is now grown in regions which had before been regarded as incapable of growing it. Winter character has been added to the spring wheats of the Pacific coast and new hybrids of these wheats are now grown there.

Methods of growing winter oats successfully in Southern States have been developed of late by some of the southern experiment stations and varieties of oats adapted to winter culture have been distributed. The Wisconsin station improved the Swedish Select oats and 5,000,000 bushels of this variety are now grown by Wisconsin farmers.

The Minnesota station originated and disseminated a promising variety of flax for seed production, and the North Dakota station achieved great success in combating the wilt disease of flax by treating the seed and by developing resistant strains.

The Department has begun experiments to ascertain the effects of close breeding. Cooperation of the Department with State stations and farmers has begun to create new strains of farm animals—carriage horses, in Colorado; cattle for beef production under southern conditions, in Alabama; the cross of the horse and the zebra, in Maryland; the reestablishment of the Morgan breed of horses, in Vermont; sheep especially suited to range conditions, in Wyoming; a breed of milking Shorthorn cattle, in Minnesota; draft horses, in Iowa; improved Holstein cattle, in North Dakota; a breed of hens for high egg production, in Maine.

INTRODUCTIONS.

Trained explorers are constantly traversing foreign and remote lands in search of promising seeds and plants for trial and possible introduction into the United States, and from this one feature of the Department's work many millions of dollars are added yearly to our national production of wealth.

From Russia and Africa durum wheat was brought during 1899 to 1902, and thus was laid the foundation of the great crop of this special kind of wheat in this country, which amounted to 45,000,000 bushels in 1907, worth $30,000,000 to the farmers, and providing exports of 22,000,000 bushels. The rice growers of the Gulf coast received superior varieties from the Orient, which have greatly increased the value of the American rice crop and given to it a firmer basis.

Sugar-beet growing for producing sugar had hardly become established in 1897, and the production of that year was only 45,246 short tons of sugar. Since that time this crop has been introduced into new parts of the sugar-beet belt, with the result that the crop of this year amounts to nearly 500,000 tons of sugar, worth $45,000,000.

So immense has become the production of alfalfa, an introduced plant, that attempts to estimate its quantity and value fail. It is supposed that this year's alfalfa hay is worth $100,000,000. This is the great forage plant and soil renovator of a vast area in the Rocky Mountain and Pacific coast regions. Its growth is extending eastward, and it has become generally established as far east as the longitude of eastern Kansas, and it is partly or fully established in spots throughout the North Central States, in the limestone regions of Kentucky and Tennessee, and in a less degree in the North Atlantic State. Several cold and drought resistant strains of alfalfa have been introduced, including an oasis alfalfa from the Sahara, resistant to alkali; various types of Turkestan alfalfa, resistant to drought; Siberian alfalfa, resistant to cold; the sand lucern, a north European variety, very resistant to cold; Arabian alfalfa, resistant to drought; Peruvian and Chilean alfalfas, suitable for culture in the Southwest.

The Swedish Select, the Tobsk, and the Sixty-day oats have been introduced and have proved of far greater value than former local varieties in the North and Northwest.

A variety of soy bean has been introduced from central China, suitable for becoming a cover crop for rice lands and greatly needed by the rice growers of the Southern States.

The best varieties of the date palm, the offspring of the oasis of the Algerian Sahara, have been introduced and established in the Southwest. The dry-land olive has been successfully introduced into Arizona and southern California.

The basic thought underlying plant introduction has been home production in place of importations, the production of wealth and the diversification of products within the Nation in place of dependence upon foreign agriculture.

FARM MANAGEMENT.

The State experiment stations, the colleges of agriculture, and the Department are placing the subject of managing the farm on a scientific engineering basis. The planning of a new farm or recasting the field plan of the old farm are being reduced to such form that they are profitably taught in agricultural schools. A number of the experiment stations have determined the kinds of crop rotations which yield the largest net returns for given soils and agricultural districts. Numerous long-time experiments on State and branch experiment station farms controlled by the Department are under way to determine those crop rotations and other methods of internal management of the farm which will be most profitable and best adapted to the family and other available labor.

In cooperation with the Minnesota Experiment Station a method has been developed of securing under average actual farm conditions the cost of each farm operation and of each crop, animal, or other product. By using these figures of cost per acre and per unit of product, and of the crop or other resulting product, a system of simplified farm accounting and cost keeping has been devised. The most novel part of this system of teaching farm management is farm maps, which serve in such a simple and convenient manner as an annual ledger of crop production cost and net income that farmers can easily use it.

Extensive studies are made of the best practices of successful farmers in all parts of the country. Demonstration of the wisdom of doing things in prescribed ways by calling attention to desirable results; plans of farm management that raise the income per acre from a paltry sum to a very profitable one; instruction in farm practices in hundreds of particulars, the success of which is readily understood in terms of profitable income—these are lines of work which have been followed and have produced widespread diffusion of agricultural knowledge and improvement.

The boll-weevil territory affords a notable example. In 1904 the Department inaugurated on a small scale what is now known as its "Farmers' Cooperative Demonstration Work." The initial efforts met with such emphatic success that the work has been gradually increased until now the whole cotton belt and many outlying regions are covered by a large force of trained field agents, all practical farmers. These men are wielding a wonderful influence among the farmers of the South to adopt better cultural methods, to use improved seed, and thus to increase their profits.

Closely related to this work are the farm management investigations of the Department, consisting primarily of a detailed study of the practices followed on the most successful farms in well-defined communities, and the application or adaptation of these practices to other and less prosperous farms throughout the country. The aim in all this work is to bring the farm up to its maximum producing power through systematic management, both as to cultural practices and as to business methods.

A practice highly important to the corn crop, that of shallow cultivation, has become prevalent in the corn belt and is growing in favor elsewhere; this counts for increased yield. In wheat culture, early plowing and thorough preparation of the seed bed are much more extensively practiced than formerly.

Dry farming has come to be recognized as an important factor in our future agricultural progress. Much useful information has been accumulated to determine the conditions under which crops may be successfully grown, the best systems of crop rotation, and the tillage required for the conservation of soil moisture to adapt new crops to the dry regions. It seems probable that as a part of this work and of the reclamation projects, a half billion acres of dry and arid land will be made available for agriculture in the course of time. The last ten years have witnessed a remarkable exodus of people from the eastern parts of the country to the western, especially to the dry part of the Great Plains. This vast region, formerly considered of little use for cultivation, is rapidly becoming one of considerable agricultural importance under the guidance of the Department and State experiment stations.

SOILS AND THEIR TREATMENT.

Soil surveying was begun by this Department nine years ago. The reason for this work is the fact that each variety or strain of crop produces its best in some certain soil and climate, and that for each soil and climatic condition there are crop rotation and farm-management schemes which pay best. The object of the survey, therefore, has been to find the proper soil for the crop, the proper crop for the soil, and to aid in devising scientific engineering plans for the management of farms on each class of soil and in each agricultural region. The survey has now covered 150,000 square miles in all parts of the United States, a larger area than the total land area of Great Britain and Ireland, or of Japan. It has led to the growing of special types of tobacco in the Gulf States, it has made marked progress in the standardization of soil descriptions, and it has brought close cooperation between the National Government and various States.

In the course of this survey the alkali problem has been solved. The rise of alkali to the surface had caused the abandonment of wide areas of land in the belief that when once it has appeared no further use can be made of such lands. The Department has demonstrated in widely separated districts in the arid West that the reclamation of areas unproductive on account of the presence of alkali is both feasible and economical.

Much attention has been given to the study of soil bacteriology, and improved strains of nitrogen-fixing bacteria have been developed and widely disseminated and have proved highly useful in the inoculation of the various leguminous crops to increase their accumulation of nitrogen.

Instruction in the conservation of the soil and its fertility by all available means has been incessantly carried on by the Department, the experiment stations, agricultural colleges, and by private publications. The importance of the cover crop to prevent winter erosion and to hold the humus and fertile elements of the soil for the benefit of succeeding crops has been one of the most emphatic teachings and has been prominent in every plan of crop rotation and farm management. The utilization of leguminous plants for enriching the soil, such as alfalfa, clover, and cowpeas, has been much extended throughout the country. So great has been the demand for cowpea, velvet bean, and crimson clover seed in the South that the farmers have been unable during the last two years to secure a sufficient quantity, even at very high prices.

VEGETABLE PATHOLOGY.

Plant diseases have been suppressed and avoided during the period under review in a far greater degree than ever before. A true science of plant pathology has been founded and the discovery of the causes and treatment of diseases has led to many improvements in mechanical methods of utilizing fungicides. Still greater advances have been made in the direction of plant sanitation, and improvements in the environment of plants as well as in the plants themselves have increased production, both in quantity and in quality. No part of the work of the Department and the experiment stations yields a more direct cash return than this.

A method of spraying trees has been devised which effectively prevents the bitter rot of apples, a disease which has caused in one year a loss of over $10,000,000.

A simple and effective method of preventing peach-leaf curl has been discovered which already saves hundreds of thousands of dollars annually. The peach-twig blight or gum disease of the peach, in California, is a disease which caused great loss of peaches in that State, but a method for its control has been discovered. The nature and method of control of the disease known as "little peach," which has threatened to destroy the peach industry of Michigan and western New York, has been determined. A method of controlling the pear blight, a disease which has destroyed the best varieties of pears in many parts of the country, including $5,000,000 worth of orchards in California, has become effective.

A new spray—self-boiled lime-sulphur—has been discovered which may be safely used in spraying peaches for the control of the brown rot, a disease which has destroyed annually from 15 to 30 per cent of the peach crop. This mixture is also a valuable general spray, as an insecticide, and is effective in the treatment of San José scale.

Among numerous discoveries are the causes and the methods of control of the brown rot of cabbage, turnip, potato, tomato, and egg plant, and of numerous other bacterial diseases of crops: the withertip and orange blight of citrus fruits, two diseases which have caused great loss; and the cranberry scald and rot, causes of heavy losses. The cause of wilt disease of watermelon and cowpea has been determined and the disease has been avoided by the introduction and development of resistant varieties of these crops where old varieties will not grow.

Investigation of the causes of decay of timbers and the methods of preventing it has resulted in improved methods of handling timbers and in impregnating them with protective substances. A cheap and effective method has been discovered for treating fence posts to prevent decay.

INSECT PESTS.

Most civilized nations have quarantine regulations to exclude insect pests, and the United States is the only exception of prominence, but in this country the subject of remedies against this class of insects has received the greatest attention. The perfection of the lime-sulphur-salt wash has practically solved the San José scale problem, and recent investigations by the Department as to the use of hydrocyanic-acid gas against scale insects on citrus trees have been so successful as to promise the saving of a large number of orchards of great value.

The discovery of the original home of the San José scale in China by a learned expert of the Department and the introduction of its natural enemy into this country was an achievement of note, but the economical use of sprays has rendered the attempted establishment of the natural enemy a matter of comparatively slight importance. The tremendous effect of the spread of the San José scale was beginning to be realized twelve years ago, but in the meantime the efforts of this Department and of the experiment stations have enabled fruit growers to save their trees from this insect.

Much has been done in practically utilizing the natural enemies of injurious insects and in introducing into the United States beneficial insects of one kind or another. This Department has introduced into California the fig-caprifying insect, which has established a strong Smyrna-fig growing and packing industry. Parasites of the gipsy moth and of the brown-tail moth have been introduced which bid fair to relieve New England from the present danger to orchards and forests, and the rest of the United States from prospective danger.

Hawaii has introduced natural enemies of the sugar-cane leaf-hopper, which have relieved the sugar-cane crop of that territory from an immense burden. Successful experiments for handling the parasites of the Hessian fly promise to be of great value to the wheat farmer. An egg parasite of the imported elm leaf-beetle has been brought from Europe.

Within the period under review studies of the cattle tick and its allies have resulted in developing a system of cultural rotation which enables cattlemen in tick-infested localities to rid their land of ticks by a simple and effective process, and a movement under Federal auspices promises to result in the eradication of this insect.

In work concerning injurious insects, the United States has been a leader among nations. Other countries have appealed to this one for assistance and advice, as well as for men to carry on similar work.

USEFUL BIRDS.

Systematic observations have been made to identify the injurious and useful birds and wild animals. In a general way it is true that most of the birds are more beneficial to agriculture than otherwise. An increasing understanding of this fact has undoubtedly checked the ruthless destruction of nongame birds and is now promoting their preservation. Some of these birds are of very large economic value to the farmer. The services of the native sparrows in destroying weed seeds have been valued at many millions of dollars annually. Were it not for woodpeckers and other insect-eating birds there would be forest destruction. Caterpillars which destroy the foliage of fruit and shade trees are the food of birds. The scale insects that infest fruit trees are eaten by no fewer than 57 species of birds. The execution of the Lacey law for the protection of game is under the administration of this Department and the interstate transportation of game in violation of law has practically ceased.

VARIOUS DISCOVERIES AND IMPROVEMENTS.

Millions of dollars have been saved to the handlers of tobacco leaf by the Department's discovery of a fermenting process for curing cigar tobacco.

A simple, cheap, and effective method of destroying the harmful bacteria and the algæ in water has been discovered and its usefulness widely demonstrated.

The important discovery was made that the loco disease of range stock was due to a metallic poison absorbed by certain leguminous plants eaten by stock on the range, and this discovery has indicated methods of control.

Laws have been enacted to protect the farmer against fraud in the purchase of fertilizers, foods, feeding stuffs, seeds, disease and insect-infested plants.

Increased and wider knowledge of the nutritive value of food and of the better utilization of agricultural products as human food has followed the nutrition investigations of this Department, in cooperation with the experiment stations and other State institutions. Animal nutrition investigations, begun in cooperation with the Pennsylvania experiment station, are accumulating most accurate and scientific information, developed by use of the respiration calorimeter, an instrument invented by experts of this Department.

The Babcock test, invented at the Wisconsin experiment station, a simple method for determining the percentage of butter fat in milk, has entered more widely into use on the farm during the period under review, and a curd test has been invented for ascertaining the percentage of casein in milk, a matter of great importance to cheese factories.

Experiment stations have been established in Alaska, Hawaii, Porto Rico, and Guam, under the supervision of the Department. There is wider and more intelligent use of fertilizers, both farm-made and commercial.

Experiments conducted by scientific men in the feeding of farm animals to determine the relationship between feeds of different kinds and quantities on one hand, and gain in live weight in growing and mature animals on the other, have resulted in highly important discoveries which enable the farmer to feed with economy and to produce maximum results. One result of this new information is the marketing of meat animals at earlier ages than formerly, for which they are prepared by a forcing of growth. When approaching maturity of growth, the animal gains in weight at a greater and greater cost per pound of gain, and the fattening of a mature animal is a relatively expensive proceeding. Farmers have availed themselves of this knowledge generally throughout the principal live-stock States.

MARKETING PLANT PRODUCTS.

Marked improvements in methods of preparing, shipping, storing, and otherwise caring for the products of the soil have resulted from the practical field experiments of the Department and the stations. This work covers the storage of commercial seeds; the handling, transportation, and standardization of grain; and the handling and baling of cotton.

Perhaps the widest popular interest has been in the work of improved methods of caring for perishable products, chiefly fruits. The Department has examined the practices followed in the California citrus groves, in the warehouses, and in other features of the citrus industry of that State. In consequence of this, the Department has induced the growers and warehousemen to adopt improvements which are probably saving to their industry more than a quarter of a million dollars annually. These improvements include the picking of the fruit, methods of packing, loading on cars, pre-cooling, and, indeed, the whole process from tree to market. The conditions of transcontinental shipment have been improved and attention is now given to trans-Atlantic exportation. This work has been extended to the Florida citrus industry and the deciduous fruit industries of New York, Iowa, and other States.

Markets for perishable fruits, such as peaches and pears, have been opened in foreign countries, and, through improved methods of storing and handling, these fruits have been kept free from decay when shipped long distances. Improved methods of harvesting, storing, and handling apples have led to remarkable changes in the selling of the crop.

Great advance has been made in improving the methods of exporting and grading grain. An apparatus has been developed and introduced for quickly determining the moisture content of grain which has placed this feature of the inspection work on a satisfactory basis.

ANIMAL INDUSTRY.

The dairy cow maintains an industry whose products are worth more than the wheat crop or the hay crop or "King Cotton." They go to almost every one of the 19,000,000 families of the country as milk or butter or cheese, but more especially as milk. It is a matter of greater concern to the public than ever before that milk and butter should be wholesome and unadulterated. The quality and healthfulness of these products largely depend on bacteria. It has been necessary to educate the dairyman and the public in the exclusion of injurious bacteria and in the use of beneficial bacteria of such kinds as impart the desired flavors to butter and cheese. Such education has been immensely promoted by the work of the Department and of the experiment stations during the period under review.

This Department has organized and perfected a system of inspection of dairies and milk-distributing plants which within two years has been adopted by over 140 of the larger cities. It has great value in giving to dairies a definite rating on the basis of a score card in which 100 points are perfect, and the application of this inspection is distinctly educational. Definite things are pointed out where improvement can be made, and the system has been received with great favor by the authorities in charge of dairy inspection.

Under a special appropriation by Congress a systematic effort, in cooperation with State authorities, has been made to introduce dairying into the South where it has not existed before. It has been demonstrated beyond doubt that dairying can be carried on profitably in the South, and not only have southern farmers been enthusiastically engaged in the work, but some of the States have made appropriations for its extension.

Supplementary to the inspection of creameries performed by State dairy officers, this Department has initiated a system of market inspection of butter followed by reports back to the creameries in which it is made, the object being to provide the butter maker with information concerning defects. Through the efforts of the Department there has been a general awakening on the part of creamery owners and managers to the immense loss annually sustained by reason of incompetent business management, and the publicity given to this work has caused three great dairy schools to offer this winter for the first time special courses in creamery management.

The educational work of the past twelve years in behalf of improved dairy conditions has caused, through private means, the organization of a national dairy show association, which holds an annual show in Chicago. It brings together everything in dairying from the breeding and feeding of dairy stock to the finished dairy products in the form of butter, cheese, and milk. It is the center of a great annual gathering of dairymen in the broadest sense of that term and is becoming a great factor in dairy education and advancement.

Butter making in the home dairy and creamery has been almost revolutionized by the introduction of the farm separator, which separates cream from milk by a centrifugal process. The shallow pan or crock system and the deep-setting system have been largely eliminated, and with their exit a considerable part of the drudgery of the household disappeared. The farmer is now no longer required to make the daily trip to the creamery; he can retain the skim milk to feed his calves and pigs and deliver the cream, sweet, every other day, when properly cared for, and this substitution of cream delivery for milk delivery by creamery patrons saves them labor and millions of dollars yearly in expense.

Dairy education at our agricultural colleges has proved most effective. Short " trade dairy school " courses have been provided for those already experienced in the work of cooperative and proprietary creameries and cheese factories. By such means American butter and cheese have been revolutionized in quality and uniformity and greatly increased in quantity and at the same time in the prices they command. Home dairying, as taught in agricultural schools, is also having a marked influence on the amount and quality of dairy products produced and on the profits from dairy farming.

Meat inspection under the National law has extended from a few of the larger packing establishments doing an export business in the largest cities twelve years ago to all the establishments of the country conducting an interstate or export trade in meat and meat food products. The scope of the work has been enlarged to include the supervision of the handling and the preparation of all meat food products and the sanitary conditions under which they are produced, as well as the thorough inspection of the animals for disease before slaughter and at the time of slaughter. Inspection is now maintained at about 800 official establishments; market inspection is maintained in 35 cities; certificates of exemption from market inspection are held by 1,992 retail butchers and retail dealers. During the year ending June 30, 1908, 54,059,901 cattle, sheep, swine, and goats had ante-mortem inspection; 53,973,337 of the same sort of animals had post-mortem inspection, and the meat and food products inspected weighed 5,958,298,364 pounds.

Important discoveries worth many millions of dollars to the farmers of the country have been made concerning the causes of and cures for animal diseases. The cause of hog cholera having been discovered, a cholera serum was prepared, and its use has demonstrated that it is a practical, trustworthy, and cheap preventive of this disease.

Methods of quarantine control of hog cholera have been worked out in some States and, with a preventive in the form of a serum, there is rising the hope that this disease, which causes millions of dollars of loss annually, may be eradicated.

After several years of experiments it was discovered by the Department that human tubercle bacilli were capable of producing tuberculosis in cattle, and that tubercle bacilli isolated from cases of tuberculosis in children possessed all the characteristics of tubercle bacilli of bovine origin, thus pointing strongly to the danger of human infection from bovine sources.

Great progress has been made in devising methods of freeing herds of cattle from tuberculosis. Some States have induced all breeders of pure-bred cattle so to handle their herds as to be able to sell only tuberculosis-free breeding animals.

In 1896, 35,000 doses of tuberculin and 1,200 doses of mallein were distributed free of charge to officers of health throughout the country for testing dairy cattle for tuberculosis and horses for glanders. In the year ending June 30, 1908, 213,000 doses of tuberculin and 52,000 doses of mallein were distributed. Thus it appears that the efforts of the Department to assist health officers and farmers in the reduction of bovine tuberculosis are bearing fruit. Since 1901 all imported cattle have been subjected to the tuberculin test.

In 1896 a satisfactory vaccine for the prevention of blackleg in cattle having been discovered, its manufacture and free distribution to the cattle raisers of the United States were begun. The use of this vaccine has constantly increased, and during the past fiscal year 1,154,100 doses were prepared and sent out.

Owing to the rapid extension of sheep scab over the ranges of the West, it was deemed advisable in 1900 to begin active measures for its restriction and eradication. This work has been continued subsequently and now several States have been entirely freed from this disease. In 1903 similar work was undertaken against scabies in cattle and considerable headway has been made toward the eradication of that disease.

A method was perfected in 1903 for the rapid diagnosis of rabies, which consists of microscopic examination of the central nervous system where the presence of minute animal cells, known as Negri bodies, indicates the disease.

The losses from milk fever in dairy cows formerly reached a high figure, since only the more valuable cows in the herd are affected. In 1904 it became known that the injection of sterilized atmospheric air into the udder of the affected animal almost invariably resulted in a cure, and this method of treatment has been widely adopted through the efforts of this Department.

Texas fever has long been a cause of serious losses to the cattle industry of the South. After the discovery that many sections of that region were but lightly infested with the cattle tick which causes Texas fever, a movement was started in 1906 for freeing such sections of this insect, with complete success within an area of 64,000 square miles.

A strict quarantine system protects our live stock against the dangerous infectious diseases which prevail in other parts of the world, so far as they are liable to be introduced by imported live animals; and when on rare occasions some malady, such as foot-and-mouth disease, gains entrance into the United States in some other way, it is promptly eradicated.

CROP REPORTING.

From the moment when the planting and sowing of the seed have begun, popular interest in the prospective quantity of the crop production continues until the harvest; and the interest in cotton, wheat, corn, and some other crops is world-wide. To provide information concerning the condition of growing crops, the amount of the harvest, the number of farm animals, and other statistical details at the earliest date and in such a way that it may be given to everybody at practically the same time, and not be available to even one person in advance, the Department's crop-reporting system has been recognized and safeguarded beyond peradventure of premature use of its reports.

Statements upon which these are mostly based are kept under seal and lock and key until they are considered, and the persons who handle them on the days when reports are issued are in confinement until these reports have gone by telegraph to every part of the country. Instead of being prepared by one person, as formerly, the reports are constructed by a corps of five persons, no one of whom can foresee what they will be in any particular.

The crop-reporting work has been much improved in other respects, one of the most important of which is the establishment and development of a service of traveling field agents, with three branches. One is a general service in which each man devotes all his time to travel and inquiry; another is a partial service of personal inspection performed by a man in each State, who also has a corps of correspondents, and a third is a special service for selected crops in which the field agents travel and devote their attention to their specialties.

So great have been the improvements of the crop-reporting service and so well is it protected against abuse that it never before stood so high in public estimation as it now does.

AGRICULTURAL CHEMISTRY.

At the beginning of the period under review the work of the Department in agricultural chemistry was confined to an analysis of soils, fertilizers, dairy products and cereals, and to sugar-beet investigations; at the close of the period there is not an industry nor an activity bearing upon the welfare of the farmer that is not studied chemically, whether he be considered as producer or consumer.

Only a few of the particulars can be mentioned and these briefly. The manufacture of sirup from cane sugar has been studied, including the fertilization of the plant, improved methods of manufacture, and the chemical control of the factory operations with a view to producing a profitable merchantable product. In connection with this the suppression of sophisticated products and the proper labeling of substitutes are seen to be of very great agricultural importance in fostering the production of legitimate sirup.

Environment studies based on the chemical examination of products grown in different parts of the United States under close supervision have afforded valuable information as to the effect of variations in temperature and rainfall on the sugar content of beets and Indian corn and the protein content of wheat.

A chemical study of the composition and effects of insecticides and fungicides, the establishment of the futility or even harmfulness of some of them, and of the loss to the farmer resulting from false claims made on the labels of such products, have led to a movement for National legislation on this subject, many of the States having already enacted laws governing the sale of such products.

The problems of soil analysis and fertilization have been attacked along the most painstaking and conservative lines, involving extensive pot experiments and the comparison of various methods of soil and plant analysis to determine the specific fertilizing needs of a given soil for a stated crop. The simple consideration of the determination of potash, nitrogen, and phosphoric acid in the soil has given way to the most complex studies of all soil constituents, both organized and unorganized.

Microchemistry and bacteriological chemistry have come to the aid of the soil and the food chemist especially and play a conspicuous part in solving the problems and meeting the emergencies which confront the practical chemist of to-day. Physiological chemistry has become an essential factor in the work, especially in the determination of injuriousness of preservatives or coloring matters added to foods and the specific action of certain drug products.

An important piece of legislation, in which chemistry has played and must continue to play a conspicuous part, is the denatured-alcohol act, for only by opening up possibilities for the utilization of agricultural wastes in its production and ultimately furnishing to the farmer a convenient source of light, heat, and motive power, and to the trade a cheaper industrial alcohol, can the object of the law be fully attained.

The economic trend of much of the work in agricultural chemistry is further illustrated by the studies made to prevent the injury to forests, crops, and stock by wastes from smelters and factories, while at the same time the manufacturer may learn from the chemist, in many cases, to convert a waste, previously a menace, into an additional source of profit.

While the chemistry of the sugar beet twelve years ago was largely concerned with the problems of its introduction, the chemistry of to-day has to consider the improvement and extension of a successful industry, in the production of a beet of high sugar content, in solving the problems which arise in manufacturing the sugar therefrom, and in converting the wastes into merchantable products, the latter being successfully effected in several ways. Here, as in the canning industries, the production of tannins, the making of paper, and the production of turpentines, the part played by chemical research in improving processes, introducing new materials, and conserving resources reacts to the benefit of the farmer, not only in increasing the market for his produce, but by enabling him to improve the character of his crop and insuring the return to him of a better manufactured product. An investigation apparently so far removed from immediate interest to the farmer as the extensive paint and varnish investigations now making is found to concern him in the production of flaxseed for the manufacture of linseed oil.

The great agricultural interests of the country have had no more efficient and unflagging servants than the official chemists, both in Federal and State employ, who have labored in their behalf. As an index to the growth of this service it may be noted that the Association of Official Agricultural Chemists, which in 1897 mustered some 58 members with 9 referees, considering soil and fertilizer analysis, dairy products, fermented beverages, sugar, tannin, and feeding stuffs, in 1908 had 200 chemists assembled in convention who were concerned in the official control of foods and fertilizers, whose standards and methods are quoted in the courts, in administering the laws, and whose referees and associate referees, conducting work on every phase of food and agricultural chemistry, numbered about 50—nearly as many as the entire attendance at the meeting held twelve years ago.

PURE FOOD AND DRUGS.

Throughout this period the researches of chemistry into the composition of foods and their sophistication, and the publication of these results, have been slowly creating the public opinion which resulted in the passage of the food and drugs act of June 30, 1906. Back of this result lies a mass of laborious detailed work and scientific research necessary to differentiate between pure and impure products, to establish standards, to prove to the manufacturer the practicability of maintaining such standards, and insure their maintenance in the courts. Should this seem a far cry from the progress of agricultural chemistry, it must be remembered that the repression of sophistication means the increased demand for the best and purest products, besides the protection of the public health.

The report of the Chemist for 1897 contained plans for work on infants' and invalids' foods and the study of cereals and milling products; the report for 1908 contains the account of the first year's work under the pure food and drugs act, with a fully organized corps of 40 inspectors at work in the field, 21 inspection laboratories scattered through the country, and behind these, as they were behind the first movement toward the law, scores of specially trained chemists and bacteriologists, performing not only the mass of routine chemical work necessary to inspection, but conducting researches into every phase of food and drug chemistry necessary to the just enforcement of the law. The public health ranks very high in the welfare of the Nation, and without the progress which has been made in agricultural chemistry, though it be detailed and not capable of description under specific discoveries, the need of the food law would hardly have been discovered and the public opinion necessary for its passage could not have been aroused, nor could its provisions have been executed after its passage.

ROAD IMPROVEMENT.

The United States has now entered upon a great era of road improvement. The State aid and State supervision plan, beginning with New Jersey in 1891, has been adopted in principle by about twenty States, resulting in large appropriations from State funds, skilled supervision by competent highway engineers, and in many cases the utilization of State prisoners for road work. In many States individual counties are accomplishing by large bond issues and practical management results as satisfactory as are accomplished by State aid.

The demand for men specially qualified in highway engineering is increasing at a rapid rate, and for this reason the Department has cooperated with educational institutions and urged the establishment of courses in highway engineering, or a modification of civil engineering courses, so as to provide the necessary instruction. Many colleges and universities are making definite progress along these lines. In connection with this movement, the Department has for several years appointed annually a small number of graduates in civil engineering and given to them thorough and practical training in highway work for one year. A number of these young engineers have passed from the Department's service to important situations in State and county road work.

The demands upon the Department for expert advice on road construction and maintenance have grown continuously in recent years both in volume and complexity, so that a corps of consulting highway engineers of the widest possible experience and adaptability has grown up, supplemented by specialists in various methods of construction and lines of experimentation.

Some States are rapidly giving more permanent construction to the principal highways. The State of New York in a recent year expended for this purpose more than $1,000,000; Massachusetts, about

$575,000; Connecticut, about $220,000; New Jersey, about $250,000; Pennsylvania and Vermont, about $130,000 each. Among the States that have pushed this work the more rapidly are Massachusetts and Rhode Island, where about one-half of the mileage of the public roads is improved; Indiana and Ohio, with more than one-third improved; California, with about one-fifth; Connecticut, Kentucky, New Jersey, and Wisconsin, with more than one-sixth; and Illinois, Maine, Maryland, Michigan, New Hampshire, New York, Tennessee, and Utah with about one-tenth.

WEATHER SERVICE.

The field of daily telegraphic meteorological observations for forecast purposes, which in 1896 was limited to the United States and Canada, has been extended by the Department to embrace at the present time the whole northern hemisphere. Forecasts which formerly were limited to a period of twenty-four to forty-eight hours in advance are now frequently made from four days to a week in advance. In 1896 forecasts were telegraphed daily at Government expense to 1,896 distributing stations, from which points they were distributed by mail, telephone, railway train service, and railway telegraph service to 51,694 addresses without expense. On June 30, 1908, the daily forecasts were being telegraphed at Government expense to 2,334 distributing centers, from which points they were distributed gratuitously to 76,154 addresses by mail, 58,008 by rural delivery, 2,139 by railway telegraph, 852 by railway train, and 3,553,067 by telephone, making a grand total of 3,690,220 addresses, of record, receiving the daily weather forecasts without expense, except for the initial cost of telegraphing the information from the forecast district centers. The storm-warning display stations have been increased from 253 to 321. There has been an addition of 78 stations where daily meteorological observations are taken and telegraphed.

The output of daily weather maps has been increased about 25 per cent, and a number of large glass maps for the display of weather information have been installed at the boards of trade and chambers of commerce of the principal large cities of the country.

The number of cooperative stations where observations of temperature and rainfall are made for use in establishing the climatology of the country has increased by 621.

The field covered by the river and flood service, which in 1896 embraced only the principal navigable rivers, has been extended so as to cover every river of importance in the entire country, except where the lack of necessary facilities has prevented efficient communication; and the number of district centers has been increased by 30, the river-gauge stations by 231, and the rainfall observing stations by 69.

A research observatory was established at Mount Weather, Virginia, in 1903, for studying the upper air and investigating the higher problems of meteorology. Problems of water evaporation have been investigated at the Salton Sea and at principal reservoirs of the Reclamation Service. The ocean meteorological service, which has been transferred from the Navy Department to this Department, now includes reports from over 2,000 cooperative observers, and from these reports are prepared data for publication on the Pilot Chart issued by the Hydrographic Office. Buildings for use as meteorological observatories and living quarters for observers at stations have been erected or purchased at 37 places. Valuable works on climatology and meteorology have been prepared and published, including the climatology of the United States, a revised method for the reduction of barometric observations, and the preparation of new temperature and rainfall normals.

Great improvement has been made in the equipment of instruments used in the weather-forecasting service. A standard station meteorograph for the automatic and continuous registration of wind direction and velocity, sunshine, and rainfall has been developed and perfected, and every regular telegraphic reporting station is now equipped with it as well as with other automatic recording instruments, so that all local atmospheric conditions are now registered with great accuracy. A special meteorograph for use in upper-air exploration has been devised and brought to a high state of efficiency and is now used at the research observatory at Mount Weather.

To meet the demands for local meteorological data a form of street instrument shelter, or kiosk, has been devised, of neat ornamental design, for use in the parks or on sidewalks in busy parts of the larger cities. Within this shelter are displayed, behind protecting glass fronts, instruments giving continuous records of temperature, humidity, rainfall, etc., together with an appropriate display of daily weather maps, climatic charts, and other publications of special local interest.

The allotment of money for telegraphing and telephoning weather reports has been increased by 25 per cent during the period under review. New submarine cables have been laid from Key West to Sand Key, Florida; from Sleeping Bear Point to South Manitou and North Manitou Islands, Michigan; from Charlevoix to Beaver Island, Michigan; and from Point Reyes to the Farallon Islands, California—these isolated stations being maintained for the benefit of extensive shipping interests.

FOREST SERVICE.

For Americans ten years ago forestry had neither a practical basis nor practical interest. On July 1, 1898, there were two professional foresters in the employ of the Government, less than ten in the whole country, no school of forestry on the Western Hemisphere, no scientific knowledge of the first principles of American practice in existence. The very word forestry was usually meaningless except as it was misunderstood.

The foundations of the present National Forest policy had, it is true, been laid. Yet so feebly were these foundations supported by popular approval and so dubious was the prospect for rearing a proper superstructure upon them that there was no security for their permanence. President Cleveland had by his proclamation of February 22, 1897, turned at a single stroke over 21.000.000 acres of public land into National Forests, but because of the belief that this action meant their withdrawal from use a storm of protest had led to the suspension of the effect of the proclamation for a twelvemonth, during which the whole reserve policy hung in the balance. The law of June 4, 1897, which accomplished this suspension, also laid down the lines along which the Government's forest policy has ever since developed by defining the purpose for which forest reserves could be created and authorizing their protection and administration; but not until more than half a decade afterwards was there an application of anything actually approaching forestry.

A complete change has been wrought in the attitude of the public toward the forests primarily and mainly by a knowledge of the facts shown by this Department. The change in public sentiment and the growth of forest service have been most rapid. The Department employed but 14 persons in 1897 in this work. Not an acre of land, public or private, at that time was under its care or receiving the benefit of its advice. There was no equipment for field work and frequently no information available upon which to base practical advice concerning forest management. The National Forests, with a total area of 39,000,000 acres, were about to receive for the first time some organized administration and protection through the General Land Office.

At the beginning of the fiscal year 1909 the Department employed 3,753 persons in its Forest Service. Its expenditures for the year 1908 were over $3,400,000. It administered an area of National Forests which before the end of the year aggregated almost 168,000,000 acres, and which paid into the Treasury of the United States over $1,800,000 in receipts. It supervised the cutting and removal of the equivalent of over 524,000,000 board feet of timber under methods which provide not only for the renewal of the forest growth but also for the improvement of its character. It prosecuted studies to further the best use of forests and forest products throughout the United States. It proved its capacity to manage the actual practice of forestry on the entire area of National Forests, embracing about one-fourth the timbered area of the country, whenever the public need brings full use of all the forests. It is equally prepared to take the lead in introducing forestry wherever in the United States its practice is desired. It has solved the problem of preservation through use, and thereby holds in its hands for the service of the public the means by which one of the most fundamental of our natural resources may be maintained in full and permanent productiveness.

RECLAMATION ACT.

New lines of work are coming to this Department and to State officials charged with looking after agricultural interests in consequence of the law of June 17, 1902, known as the Reclamation Act. When this began to provide income from the sale of public lands for the reclamation of arid lands by means of irrigating works, a movement of great magnitude began under the Department of the Interior, the results of which are already beginning to appear. The receipts of money for this purpose, beginning with the fiscal year 1901, had amounted to $33,302,855 by June 30, 1906; the estimated receipts during the following four years ending with 1910 are $24,800,000; so that by the end of the year last mentioned $58,000,000 will have been received and mostly expended to promote agriculture on desert land.

In the prosecution of this reclamation service, many projects have been planned, the irrigated area of which, as now appears, will be about 2,300,000 acres, at a cost of about $90,000,000.

Some of these projects for reclaiming land by irrigation have bold features which give evidence of the large scale on which the Government is working to make the desert fruitful and to provide homes for hundreds of thousands of farming people—perhaps millions eventually.

The Salt River project in Arizona will irrigate 210,000 acres, and there must be made a tunnel nearly 2 miles long and a dam 1,080 feet long and 284 feet high, which will provide about 8,000 horsepower.

In the execution of the great Uncompahgre project in Colorado, which will irrigate 146,000 acres, it is necessary to excavate the Gunnison tunnel, about 5½ miles long, and another tunnel 2,000 feet long, besides excavating main canals for 77 miles and providing 5,000 to 10,000 horsepower.

The Minidoka project in Idaho, in its gravity project, will irrigate 84,200 acres, will have 130 miles of main canals and 190 miles of laterals, and provide 15,000 to 30,000 horsepower.

An irrigated area of 372,000 acres will be provided by the Payette-Boise project in Idaho, which will supply a power of 12,500 horsepower and utilize 200 miles of main canals and 100 miles of laterals.

A dam 6,200 feet long is part of the Belle Fourche project in South Dakota for irrigating 100,000 acres; the length of the main canals will be 100 miles, of the laterals 125 miles, and of the sublaterals 1,000 miles.

In 1896 the irrigated acres in this country numbered about 8,000,000; in 1908 the number is about 13,000,000, and, when projects now in the course of execution by the Reclamation Service and by private individuals under the Carey Act are executed, the total irrigable area will be 18,000,000 acres.

It therefore appears that during the period under review steps have been taken and much progress made toward placing under cultivation immense areas of desert land by means of irrigation and of so-called "dry land" by means of suitable cultural systems. The foundation has already been prepared for the advent of millions of people on previously unproductive land to pursue agriculture in many of its features under conditions which promise prosperity and an enormous addition to the Nation's permanent wealth and to its annual production. In these two lines of agricultural development, in which this Department has already been concerned in the agricultural phases, there is much work for it in the future.

AGRICULTURAL EDUCATION.

The total income of the agricultural colleges was $5,000,000 in 1897, $15,000,000 in 1908; the value of their property was $51,000,000 in the former year and $96,000,000 in 1907. The students in 1897 numbered 4,000; in 1908, 10,000.

One agricultural high school existed in 1897, and there are now 55. Not one normal school taught agriculture in 1897, but now 115 do so, besides many privately endowed schools. About half of the agricultural colleges now give training courses for teachers in agriculture; 44 States and Territories give some instruction in elementary principles of agriculture in the lower schools. The Graduate School of Agriculture for instruction of investigators and for discussion of advanced problems of research in agriculture was organized in 1902 and is now doing work under the American Association of Agricultural Colleges and Experiment Stations. A strong movement for the systematic organization of all agencies in agricultural extension work has been started within a few years, and the National Educational Association has added a department of rural and agricultural education.

Outside of schools which are for the education of youth and teachers in agriculture, the farmers have received a greatly increased degree of education by means of demonstration work and advice given orally and by letter, by countless official and private publications, by corn and live-stock judging contests, and by farmers' institutes. The number of sessions of the last named held in 1908 was 14,000, with an attendance of about 2,000,000 persons, an enormous increase over the attendance twelve years ago. About 1,200 trained lecturers are now employed in farm-institute work in all States and Territories.

The volumes and pamphlets issued by the States and Nation now number many millions annually, and supplementary to this is the circulation of the periodical agricultural papers, amounting to many millions more.

In 1897 the number of publications issued by this Department was 424, of which 6,541,200 copies were distributed; in 1908 the 1,522 publications of the Department were distributed to the number of 16,875,516. During the eleven years following 1897 this Department has printed 10,449 publications, including reprints, the distribution of which amounted to 129,129,633 copies. If the probable numbers of this year are added, the publications of the twelve years will be about 12,000 and the distribution about 146,000,000.

The Department Library has grown from 56,000 books and pamphlets in 1897 to about 101,500 in 1908. Exclusive of annual reports of societies and institutions, 1,850 periodical publications are regularly received. The increasing use of this great storehouse of agricultural information is having educational effects that penetrate to every part of the United States.

GROWTH OF THE DEPARTMENT OF AGRICULTURE.

So increasingly disposed has the public been to ask and receive the aid of this Department, and so large have been the new fields of work assigned to it by Congress, that the number of employees has increased enormously. On July 1, 1897, 2,444 persons were employed, and eleven years later, in 1908, the number was 10,420, or over four times as many. Upon localizing this increase, it appears that the number of employees of the Weather Bureau increased from 1,075 to 1,705; of the Bureau of Animal Industry from 777 to 3,152; of the Bureau of Plant Industry from 127 to 976; Forest Service from 14 to 3,753; Bureau of Chemistry from 20 to 425; and small increases in other Bureaus and Offices. It is significant to note that the increase in number of employees is mostly due to service outside of Washington, in all parts of the country. The number of persons employed within Washington is 2,488, and elsewhere 7,932.

In 1896 the Department of Agriculture was made up of two Bureaus and a number of Divisions. Seven other Bureaus have since been organized and the work of the Secretary's Office has been developed into Divisions. The general change to bureau organization has greatly facilitated the work, which has rapidly grown in volume and in efficiency. There has been developed a remarkable force of scientists, administrators, and helpers. The number of seasoned workers now ready to administer the research, the police functions, and the business of the Department is sufficient for any reasonable demand for new work.

A scheme of project statements has been devised which is centering in the Secretary's Office a plan for each line of work undertaken by the Department. This plan has now been so far tried by the Bureaus and also by a number of State experiment stations that its general use is assured. It promises to serve not only as a most valuable means of having plans for work thoroughly wrought out by leaders in charge of projects, aided by workers along similar lines and their superior officers, but also to be a most efficient agency to systematize permanently the organization of the activities of the Department.

The State agricultural colleges and experiment stations and departments likewise have developed corps of workers who are prepared to guide the great advances imminent in research, in education, and in scientific breeding. The relations existing among all these organizations were never so cordial as now, and far more effective cooperation is in vogue than ever before. The administrative officers and workers of the Bureaus of the Department and of the State institutions, having had experience in many forms of cooperation among themselves, have wrought out many of the principles governing these intricate cooperative relations.

RESULTS OF AGRICULTURAL SCIENCE ON PRODUCTION.

Tangible evidences of the beneficial results of the gigantic movement in agricultural instruction and improvement, of the unprecedented uplift of the farmer, and the betterment of country life, briefly outlined and indicated in the foregoing pages, are found in the wonderful increase in diversification and geographic extension of products, apart from any mere cultivation of new land, and are recorded with arithmetical precision by the increased production per acre of various crops for which facts are known.

It must be remembered that this country is passing through historical phases of agricultural production. First comes the exploitation of virgin land by the soil robber, a proceeding that is justified by the poverty of the settler or his lack of capital; next is the diminished production per acre, which surprises the farmer, and for which he is unable to account; next is the receipt of information from the scientist as to the means of improving the productivity of the land, with slow response; in the course of time, especially when the next or perhaps the third generation takes the farm, important advances are made, at first irregularly and mostly on the farms of the leading farmers, and subsequently with increasing diffusion and accelerated speed.

INCREASED PRODUCTION PER ACRE.

In the case of all crops for which production per acre is known, there was an increase during the last ten years and also, in a somewhat less degree, in the case of most of them, during the last twenty years. This is the general fact for the United States in spite of the damaging effect on the general average by reason of decreasing production per acre from land that has not yet entered upon the final historic stage of agriculture.

The farmers of this country have now made a creditable beginning in this last phase of historic agriculture. It is now a movement of masses as well as of leaders. It is more and more a diffused movement in place of being broken up into localized efforts. This movement has gained most of its headway during the last twelve years. Increased production per acre is clearly indicating the extent and force of this uplifting movement.

During the ten years 1877–1886 the mean yield of cotton per acre in all States, new land and old being combined, was 170 pounds; during the ten years ending with 1896 the mean was 172 pounds; and the increase from that figure during the succeeding ten years ending with 1906 was to 191 pounds, or 11 per cent above the yield of the preceding ten years.

Most interesting now is the testimony of the older cotton States to the arts and sciences of agriculture. In North Carolina the mean production of cotton per acre increased from the ten years ending with 1896 to the ten years ending with 1906 by 21.8 per cent; in South Carolina, 20.4 per cent; in Georgia, 15.9 per cent; in Mississippi, 16.9 per cent; and in Tennessee, 11.5 per cent.

Other crops join hands with cotton in swelling the evidence. Within ten years, mean figures being adopted as before explained, the production of corn per acre in Ohio increased 17.5 per cent, and in Virginia 18.3 per cent; oats increased 17.9 per cent in Indiana.

Wheat increased 16.2 per cent in New York, 45.9 per cent in Nebraska, 14.5 per cent in Maryland, 19.1 per cent in Virginia; barley increased 13.6 per cent in Wisconsin; rye, 24.4 per cent in Pennsylvania, 14.5 per cent in Michigan; buckwheat increased 14.7 per cent in Maine and 21.9 per cent in Pennsylvania; potatoes 39.1 per cent in Maine and 22.1 per cent in Wisconsin.

Increase for hay was 14.3 per cent in Kentucky, 27.7 per cent in Minnesota, 19.4 per cent in North Carolina, 19.5 per cent in Georgia, 17.6 per cent in Alabama, and 30.8 per cent in Oregon.

In some degree this upward movement began twenty years ago, for during that time corn production per acre increased 25 per cent in Illinois and 21.7 per cent in Virginia; the production of oats increased 32.4 per cent in Maine; wheat increased 30.6 per cent in Iowa, 37.3 per cent in Nebraska, 23.4 per cent in Maryland, and 27.7 per cent in Virginia; rye increased 39.3 per cent in Pennsylvania; buckwheat increased 40.3 per cent in Maine and 26.9 per cent in Pennsylvania; potatoes increased 54.5 per cent in Maine, and hay increased 23.2 per cent in North Carolina, 32.8 per cent in Alabama, and 35.1 per cent in Oregon.

DIMINISHING RATE OF INCREASE IN POPULATION.

The most important meaning of the percentages of increased production per acre is found in a comparison with increase of population. The United States is accompanying the peoples of western and southern Europe in a decreasing birth rate and in a diminishing increase of population. The population of Europe, excluding Russia and Turkey, increased 8 per cent during the ten years ending with 1880, slightly less than 8 per cent in the ten years ending with 1890, and slightly more than 8 per cent in the following ten years. These people belong to the race stocks of the United States.

In this country the increase of population is complicated with an influx of the foreign born and with a higher birth rate of the foreign born than that of the old native stock. These are having a temporary effect upon the actual rate of increase; after an elimination of these temporary elements, which serve only to mislead to extravagant computations of population at distant years in the future, the natural rate of increase of the population of this country, native born of native parents, appears to be approximately 12½ per cent during a decade, or 1¼ per cent yearly, with a tendency toward diminution in the rate. This conclusion has been elucidated by the Chief Clerk of the Bureau of the Census in recently published writings concerning this subject.

The percentages of increase of crop production per acre now have a new significance. No one need fear that the farmers of this country will ever be unable to provide for its population. They are already demonstrating in the cases of various crops and of various States that they can provide for a population increasing faster than by increase due to excess of births over deaths.

The wheat and rye production of 12 countries of Europe, representing substantially the entire production outside of Russia and Turkey, increased by 15.2 per cent from 1886–1890 to 1901–1905, and the population increased from 1888 to 1903 but 13 per cent.

WAGES OF FARM LABOR.

Extraordinary prosperity following the low financial condition of farmers a dozen years ago and earlier has enabled them to pay higher wages for farm labor than before, and this fact may indicate an improved condition of the farm laborer, at any rate to the extent that he is disposed to improve.

From 1895 to 1906 farm wages increased in a greater degree than prices did. The percentage of increase of prices of all commodities, according to recognized authority, was 35.8 per cent, while the wages of farm labor by the month for the year or season without board increased 38.4 per cent and with board 41.4 per cent; wages by the day in harvest without board increased 46.5 per cent and with board 55.4 per cent, and the wages of ordinary labor by the day without board increased 55.6 per cent and with board 61.3 per cent.

In the matter of wage increase the farm laborer has fared better than the workingman employed in manufacturing and mechanical industries.

STATISTICAL ASPECTS OF PROGRESS.

Precise ideas of the progress of agriculture, of the farmer, of his capital, of his production, and of his financial improvement may be obtained by a quantitative comparison between the average of the last five years ending with 1908 and the average of the five years ending with 1896 or thereabouts. The comparison will indicate by percentages of increase the advance that the farmer has made in twelve years.

Cotton production increased 53.4 per cent and the total value of the crop 133.4 per cent; corn production increased 25.7 per cent, compared with the census of 1890, and the total value of the crop 110.5 per cent.

Wheat's increase is 39.8 per cent in bushels and 64.8 per cent in total value in comparison with the census of 1890. For rice the increase of production is 303.3 per cent; the barley increase is 98.2 per cent for bushels and 130.9 per cent for total value.

For potatoes the increase is 35.5 per cent in production and 118.9 per cent in total value; for tobacco 35.3 per cent for production and 98.3 per cent for total value. Since 1892–1896 beet sugar production has increased 1,404.6 per cent.

The value of all products of the farm this year is an increase of 216.2 per cent over the census value of 1889.

Horses increased 33.6 per cent in number since 1890 and 81.2 per cent in total value; mules increased 68.5 per cent in number and 132.1 per cent in total value. Sheep increased 90 per cent in number and 224.5 per cent in total value; swine increased 22.1 per cent in number and 56.4 per cent in total value. Cattle, other than milch cows, increased 48.4 per cent in number and 64.9 per cent in total value, and milch cows 28.4 per cent in number and 77.8 per cent in total value.

The number of farms in 1890 was 4,564,641; in 1900 they numbered 5,737,372; and the present number is estimated to be 6,100,000, an increase of 33.6 per cent over 1890.

The total number of acres in farms increased from 623,000,000 in 1890 to 839,000,000 in 1900, or 34.6 per cent. Improved acres increased 15.9 per cent.

The capital of the farmer in the forms of land, buildings, improvements, live stock, implements, and machinery is supposed to be now worth about $28,000,000,000, an increase of 75 or 80 per cent over 1890.

The exports of agricultural products of domestic production have increased noticeably in value and in the case of many items greatly in quantity during the last dozen years. A comparison of the average for 1904–1908 with that for 1893–1897 discovers that the total agricultural exports increased 53.7 per cent in value, while the population increased 24.4 per cent from 1896 to 1908.

The increased value of the exports of packing-house products is 40.6 per cent. The exported lard gained 32.9 per cent in number of pounds and 52.6 per cent in value; oleo oil, 74.4 per cent in weight and 72.8 per cent in value; hams, 80 per cent in pounds and 90 per cent in value; salted and pickled pork, 121.8 per cent in quantity and 187.1 per cent in value.

The most prominent export, cotton, gained 40 per cent in pounds of export and 102.2 per cent in value; cotton-seed oil cake and oil-cake meal gained 115.5 per cent in quantity and 187.8 per cent in value, and cotton-seed oil about the same. Fresh apples gained 130.8 per cent in number of barrels and 224 per cent in value; all fruits gained in export value 237.8 per cent.

The farmers have given to this country most of its balance of trade in the exchange of goods with foreign countries from the beginning. To whatever extent the subject is complicated with shipments of gold and silver and with transfers of credit is immaterial to the present mention of the subject. The fact is that the farmers of this country, through the exportation of their surplus of products, have been the chief instrument of strengthening the National credit abroad, of paying the foreign holders of the National bonds of this country, and of establishing credit in foreign countries against which drafts could be made.

During the twelve years under review the agricultural balance of trade increased from a yearly average of $234,000,000 to $411,000,000, or 75.7 per cent.

As an indication of financial results, a comparison of individual deposits in all banks July 1, 1896, with those of 1908 presents striking gains in agricultural regions. While Massachusetts and New York were gaining, respectively, 61.9 and 12.2 per cent in deposits, and the North Atlantic States 112.1 per cent, the North Central States west of the Mississippi River gained 258.5 per cent; Iowa, 285.5 per cent; Kansas, 333.7 per cent; Mississippi, 404.2 per cent; Oregon, 725.6 per cent; North Carolina, 405.4 per cent; and Arkansas, 534.7 per cent.

While these were not all farmers' deposits, yet they were mostly derived from the sales of farm products by farmers and the handlers of farm products.

FARMERS' COOPERATION.

Farmers' economic cooperation in the United States has developed enormously during the period under review, and it is safe to say that at the present time more than half of the 6,100,000 farms are represented in economic cooperation; the fraction is much larger if it is based on the total number of medium and better sorts of farmers, to which the cooperators mostly belong.

PROMINENT OBJECTS.

The most prominent object of cooperation is insurance, in which about 2,000 associations have probably 2,000,000 members. This kind of insurance costs the farmers only a very few cents per hundred dollars of risk above the actual losses.

The cooperative creameries number more than 1,900 and the cheese factories about 260, the membership of the two classes being very large and representing an immense number of cows.

With the exception of insurance, the greatest success in the farmer's cooperative movement is in selling. Associations to regulate, promote, and manage the details of selling the products of cooperating farmers are found in all parts of the United States. There is cooperation for selling by fruit growers, vegetable growers, nut growers, berry growers, by live-stock men, by the producers of cotton and tobacco, wheat, sweet potatoes, flax, oats, eggs, poultry, and honey. Farmers cooperate to sell milk for city supply, to sell wool, cantaloupes, celery, cauliflower, citrus fruits, apples, and so on with a long list.

Cooperative buying is conducted by about 350 stores in this country, a majority of which are mostly owned by farmers. This is chiefly the result of a very recent movement. Another form of cooperation for buying is based on the discount plan, as carried on by the granges, farmers' clubs, and various other associations of farmers with cooperative buying as either a primary or secondary object. Things bought in this way are all sorts of store goods; potatoes, wheat, etc., for seed; coal and wood, and a great variety of farm and family supplies.

Warehousing is conducted by farmers on the cooperative plan with success, particularly for the storage of wheat and corn. A cooperative cotton-warehousing movement is of recent date.

Cooperative telephone service has permeated vast regions, and the cooperative feature has kept the cost at the lowest figure, both of equipment and of service.

Cooperative irrigation is carried on by many thousands of associations in the arid and semiarid regions.

EDUCATIONAL, SOCIAL, AND ECONOMIC ASSOCIATIONS.

The progress of farmers in forming and expanding associations of an educational and semi-economic character has made great advances during the period under review. These associations are National in their scope, or are confined to State lines or to sections within States, and are devoted to the interchange of ideas and experiences, the assembling of information for common benefit, the holding of competitive exhibitions of products, the devising of plans for the common good, and business of a like character, and are concerned with special subjects, such as horticulture, floriculture, dairying, plant breeding, live-stock breeding, poultry breeding, the scientific aspects of breeding, forestry, agricultural education, fraternal associations with incidental educational and economic features, seed breeding, agriculture, vegetable growing under glass, and the nursery business.

Important associations of the social sort, with incidental economic features, are farmers' clubs, many hundreds of which exist.

THE FARMER A GREAT ORGANIZER.

Altogether the number of farmers' cooperative economic associations must be fully 75,000, and may easily be many more, with a membership rising above 3,000,000, without counting duplicates.

Contrary to his reputation, the farmer is a great organizer, and he has achieved remarkable and enormous successes in many lines of economic cooperation in which the people of other occupations have either made no beginning at all or have nearly if not completely failed.

CONCLUSION.

The foregoing review of agriculture in the United States during the last dozen years and of the progress made by the farmer has necessarily been highly condensed, and from it has been omitted a vast amount of information which, being in the form of details, would detract from the review as it stands. Enough has been presented, however, to establish the fact that agriculture has made wonderful progress and permanent advancement, and that the farmer in results of information, intelligence, and industry has thriven mightily. The progress that has been made is in the direction leading to popular and National welfare, to the sustenance of any future population, as well as to a larger efficiency of the farmer in matters of wealth production and saving, and in establishing himself and his family in more pleasant ways of living.

Respectfully submitted.

James Wilson,
Secretary.

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